ARI Research Note 87-16

METHODOLOGY DEVELOPMENT FOR DERIVING LESSONS LEARNED FROM THE NATIONAL TRAINING CENTER: PROGRESS AND FUTURE DIRECTIONS

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As part of a 3 year contract effort, in support of the Army Research Institute's (ARI's) research program at the National Training Center (NTC), a plan has been prepared that summarizes the first year's progress, and describes the activities for the second year.

During the first year, 22 identifiable products or reports were prepared. These fell into four major areas of endeavor: measurement of unit performance, development of lessons learned, investigation of data quality,

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and creation of guides to the NTC instrumentation system.

Year two efforts will continue and expand the progress achieved, in large part through the use of an integrating model of unit NTC performance developed during the first year. This should enhance ARI's support for the development and dissemination of lessons learned from the NTC.

METHODOLOGY DEVELOPMENT FOR DERIVING LESSONS LEARNED FROM THE NATIONAL TRAINING CENTER: PROGRESS AND FUTURE DIRECTIONS

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METHODOLOGY DEVELOPMENT FOR DERIVING LESSONS LEARNED FROM THE NATIONAL TRAINING CENTER: PROGRESS AND FUTURE DIRECTIONS

EXECUTIVE SUMMARY

Requirement:

The U.S. Army Research Institute (ARI) provides research support to the Combined Arms Training Activity's (CATA) mission at the National Training Center (NTC), Ft. Irwin California. As part of this support, ARI has undertaken a multi-year research effort to investigate new methodologies for the measurement of unit performance and for the derivation and dissemination of Lessons Learned at the NTC. In this regard, ARI has contracted with The BDM Corporation to perform a three year investigation entitled: "Research Support for a Unit Home Station Training and Feedback System". One of the requirements of this contract effort is to provide an annual synopsis of progress achieved and to present a research plan for the subsequent year.

Procedure:

Each of the four first year tasks were reviewed to document progress against its intended outcomes. This review focused on the intended task outcomes, factors which influenced task performance, documentation of completed activities and resultant products.

Based upon the progress achieved in the first year and the intended outcomes for the second year tasks, a detailed plan for each task was prepared. A description of the purpose of the task, an understanding of the task, the methodology for task accomplishment and a summary of anticipated products were prepared. Milestones charts and personnel loading information were also derived.

Findings:

Twenty-two research products or reports were produced as a result of the activities performed as part of the Year One contract effort. These represented considerable progress in the areas of unit performance measurement, development of Lessons Learned, documentation of NTC data quality, and guides to the NTC instrumentation system.

The Year Two research efforts will continue and expand the progress achieved in the first year. In large part this will be facilitated through the use of an integrating model of unit NTC performance developed in the first year. It is anticipated that the results of the Year Two efforts will further enhance ARI's support to CATA's mission to develop and disseminate Lessons from the NTC.

Utilization of Findings:

This document serves a dual purpose. First, it summarizes and documents the progress and products of the first year's contract effort. Second, it proposes a plan of activities that continues the accrual of expertise and information begun in Year One.

INTRODUCTION

In February of 1985, BDM Corporation was contracted by the Army Research Institute (ARI) to conduct a three year research effort in support of ARI's mission as primary research agency for the Army at the National Training Center (NTC). Performance of this contract required that BDM successfully complete five tasks in each of the three years of the contract. The structure of these tasks was such that the output from each year's effort feed directly into the conduct of the next year's tasks. The mechanism identified in the contract for the incorporation of the previous year's efforts and results into the plans for the succeeding year was a research plan for the future activities. The present document represents the research plan for the second year of the contract effort and is the contract deliverable for Task Five of the first contract year.

Purpose of Research Plan

The research plan has been prepared in response to the requirements of the RFP, the BDM proposal, and the events of the first year of contract performance. As such, it represents both a summary of past events and intended outcomes as well as a description of future objectives, anticipated activities, and products. Specifically, this document addresses three primary topics:

1. The accomplishments and deliverables of the First Year of the Contract

2. The impact of these accomplishments on the second year program.

3. The revised plans for the second year.

Organization of the Plan

To facilitate the presentation and discussion of these topics, the plan has been organized into two sections with supporting appendices. Each section focuses on the activities of a specific contract year. Thus the first section contains a description of the Year One activities while the second section focuses on Year Two of the Contract. The structure of each of the two sections is similar in that the specific contract tasks are addressed separately. However, the purpose and nature of the discussion differs considerably from the first section to the second section.

In the first section, **Year One of the Contract**, the discussion for each task provides:

o A statement of the intended outcomes for the task as per the orginal SOW and BDM proposal;

o A delination of events or circumstances which influenced the actual performance of the task;

o A description of the progress made during the first year on the task;

o A listing of all significant products and reports produced in the performance of the task.

Preceding the Year One task descriptions is a brief introduction presenting the thrust and purpose of Year One. This sets the stage and provides a context for the individual task activities so that an assessment of progress can be meaningfully be derived. It is anticipated that the above structure provides a comprehensive review and assessment of the first year contract efforts and its results.

The second section of the document, **Year Two of the Contract**, focuses on the performance of Year Two activities. By design and requirement, this section incorporates the results of the first year as an input into the framework contained in the orginial SOW and proposal. Thus, the activities plannned and projected for the second year have been shaped and conditioned by the first year achievements and events. The effect of this approach is immediately apparent in the introduction to the second section where a model for measuring unit combat performance, an outcome of Task 2 in Year One, is presented and used as the unifying conceptualization for all Year Two activities. The specific tasks to be conducted in Year Two can be seen both in terms of their relationship to an overall model of battalion NTC performance and their relationship to each other.

Each Year Two task is presented separately in the second section of the plan. For each task, the discussion includes:

o A statement of the nature of the task
o A statement of the understanding of the task
o A proposed set of activities to address the task
o A delineation of anticipated products

In support of the discussion of Year Two tasks and activities, a staffing and resource chart is included. The chart provides the level of effort and mix of personnel for each task.

Finally, a separately bound set of Appendices has been prepared as a supplement to the plan. These Appendices include copies of all Year One reports and products. Due to their considerable volume, the Appendices are not included here. Rather, references to specific Appendices have been provided for each product or report. It is felt that this organization will not deter the ability of the reader to understand the described research effort.

Year One

of the

Contract

INTRODUCTION

As described above the initial section of the research plan is intended to provide a description of the progress achieved in the first year of the contract. To facilitate an understanding of this progress and the activities undertaken, it is important to understand that there were three primary thrusts to the Year One effort:

1. To investigate and establish the quality of the data from the NTC.

2. To design and develop a model of battalion combat performance at the NTC and the determinants of that performance;

3. To identify user needs and then develop products and reports using NTC data and also to establish a methodology for future application of NTC data.

The Year One tasks were shaped and performed to maximize the benefit to be accrued to the Army in the process of accomplishing these objectives. Evidence of this benefit is found in the partial list of Year One products presented below:

Task 1: Develop and Apply Procedures for Identification and Correction of Erroneous Data from the NTC

Program GDETAP Documentation

Capability to Analyze NTC Data

NTC Data Library

Comparison of National Training Center Digital Data Sources

Task 2: Develop and Apply Concepts and Methods for Measurement and Interpretation of Unit Performance

An NTC Live Fire Performance Analysis

A Briefing on a Concept and Methodology For Measuring Unit Combat Effectiveness at the NTC

A Research Plan for Developing Concepts and Methods for Measurement and Interpretation of Unit Performance

A Briefing On a Preliminary Analysis of NTC Force-on-Force Performance

A Preliminary Analysis of NTC Force-on-Force Performance

Task 2 (Cont'd):

A Briefing on the Performance of Battalion Task Forces on the Live Fire range at the National Training Center (NTC)

A Research Plan for Measuring Unit Performance Effectiveness

National Training Center Research Issues

Comparison of the BFVS and M113 Equipped Battalion Task Forces on Live Fire Performance at the NTC

Task 3: Develop Guides to the Use of NTC Information

A Detailed Description of the NTC System Initialization Procedure

Lessons From the NTC

Interview Guide: Unit Home Station Training and Feedback System

A Briefing on the Use of Instrumentation to Improve Combat Readiness

Research Plan for the Evaluation of Acoustic Quality and Research Potential of Communication Recordings from the National Training Center (NTC)

The DeAnza Primer: A Basic Introduction to the DeAnza Graphics Display

Documentation for "What Now, Captain?": A Training Concept for Exporting Lessons Learned from the National Training Center

A Method of Analysis for the Investigation of the Bradley Fighting Vehicle at the National Training Center

Task 4: Determine Requirements for More Effective Integration of NTC and Home Station Training

Research Plan for the Evaluation of the Requirements for the Effective Integration of the National Training Center (NTC) and Home Station Training

The remainder of this section is organized around the four tasks of Year One. A brief description of the tasks is provided below:

Task 1 -- **Develop and Apply Procedures for Identification and Correction of Erroneous Data from NTC**: This task has as its central concern the investigation of the quality of the digital data from the NTC. As part of this effort, several comparisons were undertaken to determine the relative accuracy of varying data sources.

Task 2 -- **Develop and Apply Concepts and Methods for Measurement and Interpretation of Unit Performance**: Defining and Measuring Battalion Combat Effectiveness was the central issue for this task. The work undertaken in Year One resulted in the development of a new systems model of combat effectiveness.

Task 3 -- **Develop Guides to the Use of NTC Information**: Work on this task followed two different research strands. One strand led to the creation and production of a prototype "Lessons from NTC". The other strand was concerned with the preparation of guides for use at the NTC by personnel working with the NTC instrumentation system.

Task 4 -- **Determine Requirements for More Effective Integration of NTC and Home Station Training**: Capitalizing on the model developed in Task 2 and the result from "Lessons from NTC", the effort undertaken in this task provided a research plan for implementation in Year Two. The focus of this plan was Home Station Training factors related to NTC performance.

The discussion of each task is intended to provide a thorough assessment of the conditions surrounding the performance of the task, its progress relative to these conditions, and its products. In providing this assessment, the nature of each task should be clear as well as its contribution to the achievement of the overall objectives for the first year.

I.1 Task 1 -- Develop and Apply Procedures for Identification and Correction of Erroneous Data from the NTC

I.1.1 Intended Year One Outcomes

Four subtasks were identified in the Proposal for this task:

(1) Prepare a Research Plan for Examination and Selection of NTC Data,

(2) Develop Methods to Review and Annotate Data,

(3) Design and Implement Macro-Level Raw Data "Cleaning" Methodology, and

(4) Produce Report Describing Methodology for Performing the Task and Providing Recommended Procedures for Routine Use.

I.1.2 Factors Influencing Task Performance

Three major factors caused a major redirection in the Task 1 effort from that originally proposed and presented above:

(1) The emphasis by ARI changed to short, quick-reaction analyses. As a result, Task 1 resources were placed in support of repairing the NTC Database Research System and implementing procedures to allow it to be used more easily.

(2) The lack of documentation for the NTC archival data made any substantive analysis impossible without a major analysis effort. In effect it would have been necessary to apply "reverse engineering" techniques to the software in order to decipher the formats of the input files.

(3) The discovery of an alternate digital data source (the Range Data Measurement Subsystem log) was considered important enough that a detailed analysis of that source was added to the Task 1 schedule.

I.1.3 Description of Year One Progress

As a result of the factors listed above, the subtasks actually performed during Year 1 included:

(1) Achieve operational capability for the NTC Database Research System (NTCDRS),

(2) Identify and investigate additional sources of NTC data, including Take Home Packages and the RDMS log tapes, and

(3) Initiate the process of redesigning the NTC database to more capably support ARI-POM research objectives.

I.1.3.1 NTC Database Research System (NTCDRS)

The NTC Database Research System (NTCDRS) is a contractor-developed (SAIC) system which was designed to convert the log tapes received from the NTC into a form that would facilitate analysis and research. It was implemented as a series of computer programs which culminated in a series of relational database tables that could be accessed in combination to provide simple reports, including rudimentary statistics.

As implemented, the system was deficient in several areas:

(1) It was limited to the creation of one database, which included the data from one mission in one rotation. This limitation resulted from hard-coding the database name (ARIDATA) in the program.

(2) The system was prone to fail catastrophically at a number of points.

(3) Operation of the system was invoked by use of a number of command files which were badly documented, awkward to use, and error-producing.

As of 1 September, 1985, the NTCDRS was operational. This was achieved by overcoming the deficiencies listed above by:

(1) Making the database name an input option. This allows the generation of a database for each mission segment in each rotation. A naming convention was selected which provides for a unique (and standard) name for each mission segment processed.

(2) Each problem which caused a catastrophic failure was analyzed and overcome. A variety of methods were used, including generation of short FORTRAN programs, the use of system editors, and judicious deletion of garbled data.

(3) New command files were generated which allow for much more straightforward processing. In addition, fixes for some of the more persistent problems were incorporated into the command files to eliminate the requirement for operator intervention.

In addition to the steps listed above, approximately thirty utility programs and command files were developed to allow for specialized processing needs, such as reloading specific tables, documenting database contents, and dumping intermeciate files.

Since production was initiated, more than 500 mission segments have been processed by NTCDRS and are available for use.

I.1.3.2 Additional NTC Data Sources

The identification and investigation of additional data sources from the NTC was intended to ensure that future ARI-POM research efforts would make use of the full range of data available from the NTC. The ultimate outcome of this effort would be the incorporation of the additional data into a redesigned NTC data base. Part of the accomplishment of this job was the identification of all NTC data sources available, an inventory of all NTC material available at ARI-POM, and establishment of an NTC Library at ARI-POM.

The next step included a more in-depth analysis of the data contained in sources not previously examined, and a determination of what, if any, data from the "new" sources was relevant to the upcoming research program that was not already present.

The initial effort in this regard resulted in the preparation of two reports concerning NTC battalion performance, based on data from the take home packages (THPs), one of the primary sources of data routinely produced at the NTC. Based on the utility of THP data, they should be incorporated into the redesigned data base. Selection of THP data to be included, designing their format, and developing a means of incorporating them into the redesigned NTC data base are all steps properly included in the data base design and development task.

Another NTC data source was also examined in detail: the log tapes from the Position Tracking Computational Component (PTCC) of the Range Data Measurement Subsystem (RDMS), referred to as RDMS log tapes. These data, and their comparison with data from the NTCDRS, were the subject of a BDM report which is summarized as follows. First, analysis indicates that raw data from the RDMS log tape are transmitted to the Core Instrumentation Subsystem (CIS) and logged with a great deal of fidelity. Second, there are critical data on the RDMS log which are not available from the CIS log. Third, software has been developed which allows processing of the RDMS log, and will facilitate incorporation of selected data into the redesigned data base.

While some preliminary analysis has occurred, detailed specification of additional data to be included in the follow-on data base is properly a function of the data base design effort.

I.1.2.3 NTC Data Base Redesign

The initial design of an NTC database, as implemented by the NTCDRS, prepared by SAIC, has certain shortcomings:

(1) The data contained within the NTCDRS databases are adequate to support only a small percentage of the research efforts possible with access to all NTC data.

(2) The data within the NTCDRS tables are arranged so that they are awkward to use. The development of useful database queries is difficult and time-consuming.

(3) Design of the present database structure is deficient, in that there are multiple occurrences of identical data, awkward data relations or keys, and common inclusion of data that can be derived easily from other tables.

The remedy to the problems discussed above is to redesign the data base so that it properly supports the NTC research objectives of ARI-POM. This is a fairly long term process which must consist of the following steps:

(1) Requirements Analysis. This step specifies the data base, in terms of which data are required, including explicit definition, accuracy, units, and derivation, if necessary.

(2) Design. This phase allocates the requirements into data base terms, including choosing the database structure down to the table structure, data relations (i.e. the specific data tables), and keys. Also included in the design effort are complete specifications of all data sources, down to explicit format information, and design of the processes which will be necessary to incorporate the data into the new data base structures.

(3) Development. During this phase, the processes necessary to build the new data base are developed. The processes might include computer programs, command files, manual entry, data verification, derivation of some data elements, etc.

(4) Implementation. This phase provides the transition into a production status, and ties all of the separate entities developed in the previous step into a working system. In the ARI-POM environment, the implementation also includes the retrofit of data presently in the NTCDRS format into the new data base format.

The previous discussion serves as background to the totality of the database definition process. While the process, as outlined, appears to be a sequential and logical progression to a logical conclusion and product, in reality the process had elements of serendipity, since the efforts documented in the first two subtasks of this document contributed to the design process. Likewise, it must be assumed that the residue of efforts expended in the production of ARI-POM research reports can and will contribute to the requirements definition.

What is necessary is the formalization of the process, without which any data base redesign will result in a substandard product. The completion of the data base design effort is projected as Task 6 of Year Two of the Contract.

I.1.4 List of Significant Reports and Products

A list of the four reports produced in the process of performing Task One appears below. Copies can be found in the indicated appendices.

1.0 Program GDETAP Documentation

2.0 Capability to Analyze NTC Data

3.0 NTC Data Library

4.0 NTC Data Comparison: RDMS vs. CIS

I.2 Task 2: Develop and Apply Concepts and Methods for Measurement and Interpretation of Unit Performance

I.2.1 Intended Year One Outcome. The development of a method for measuring and interpreting the performance of critical tasks for a sample mission conducted at the National Training Center (NTC) was the primary intended outcome for this task.

This outcome was to be achieved through the accomplishment of the following seven subtasks in the order shown in Figure I-1:

Subtask 2.1: Prepare a Research Plan for Task 2

Subtask 2.2: Describe Mission Essential Tasks for the Task Force and for each Major Element of the Task Force

Subtask 2.3: Identify Measures of Performance (MOPs) and Measures of Effectiveness (MOEs) for use with NTC Data for Each Activity or Task

Subtask 2.4: Develop and Apply NTC Data Files as well as Extraction and Analysis Procedures for these Tasks and MOPs/MOEs

Subtask 2.5: Produce Sample Performance Analyses and Profiles Across and Within Battalions

Subtask 2.6: Develop Integrating Concepts, Procedures, or Models for Interpreting the Performances

Subtask 2.7: Produce Reports

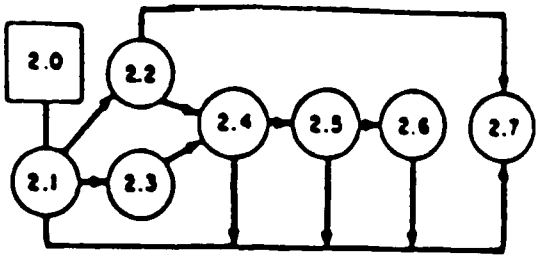


Figure I-1. Task 2 Sequence of Subtasks

I.2.2 Factors Influencing Task Performance.

As a result of specific instructions and guidance from ARI, satisfaction of near term research requirements became a major focus for this task. This change in emphasis was necessitated by issues that had been raised after the contract was let concerning the utility of NTC data for research. Therefore, the COTR (Dr. Banks) determined at the beginning of the contract period that

immediate efforts should be expended to determine the usability and value of NTC data by producing reports in the short term, researchable issues of military significance which would have interest for senior Army leadership. With this guidance, we began to research the data sources to determine the feasibility for producing such reports. The Take Home Packages appeared to offer the most complete and readily useable data for conducting the type of research desired by the COTR.

I.2.3 Description of Year One Progress.

Due to the above direction from the COTR, we undertook Subtask 2.5 first. This effort was followed by work on the remaining subtasks. The progress made on each of these subtasks is discussed below.

Subtask 2.5: Using the data from the Take Home Packages, we were able to perform an analysis of the performance of 56 battalions on the live-fire range. A comparison was made of their performance over time and between the two types of task forces (Armor versus Mechanized Infantry). Possible causes for performance changes were investigated and reported. A second analysis was conducted of the performance of 64 battalions during force-on-force engagement simulation offensive and defensive missions. In this latter analysis, a comparison of the friendly and OPFOR losses by type task force for tanks and APCs was performed. The impact of J-series organizations versus H-series organizations on performance results was also investigated. Possible causes for variation in performance were studied and the results reported.

These two sample analyses constituted partial fulfillment of the original Statement of Work. Additional analyses were conducted as part of Task 3 and were incorporated into "Lessons from NTC" as further illustrations of performance analysis possible with NTC data. What remains to be accomplished are sample performance analyses based on a model/methodology designed to measure the performance of mission essential tasks.

Subtask 2.2: A preliminary effort was undertaken to identify the mission essential tasks for the task force for the two defensive missions of "Defend in Sector" and "Defend from a Battle Position" and for two offensive missions of "Deliberate Attack" and "Movement to Contact". FM 71-2J and military SMEs were used to develop this preliminary list of critical tasks. It should be noted that analyses were also conducted on mission essential tasks as part of an "NTC Lessons" effort. This effort is described in detail under Task 3 though its results were incorporated into the Task 2 efforts.

Subtask 2.3: As part of the effort directed toward an analysis of live-fire and force-on-force performance, as well as development of "Lessons From NTC", initial development of measures of performance and effectiveness was accomplished. Specifically,

measures of performance were identified which could be used in the descriptive and inferential analyses conducted in these areas. While these measures do not represent a complete or exhaustive set of performance indicators, particularly in the area of critical tasks, they do constitute a reasonable starting point for measuring and understanding certain aspects of NTC performance.

Subtask 2.4: The problems indicated in the description of Task 1 greatly constrained the potential application of the NTC data files for extraction and analysis. However, two different activities contributed to accomplishments for this subtask. First, a data base was developed and used for both the live-fire and force-on-force analyses. As described above, this data base included the MOPs and MOEs identified and developed for these analyses. Second, as part of the Task 3 effort, sample analyses of fire control and fire distribution were performed using the NTC data files. These analyses drew upon all data sources including the graphic displays and the digital data from the CIS. The resultant analyses employed both graphical and numerical summaries of the NTC data and represent prototypes for future analyses of mission performance. The extraction procedures created in the performance of this effort have been documented and disseminated to ARI for their use.

Subtask 2.6: In October 1985, a model was developed for integrating and interpreting not only the critical task performances but other organizational factors, such as cohesion and leadership, as well as to show the relationship of these variables to home station conditions. The model was produced and briefed to the new commander of ARI, COL Henderson. A formal report of this model and the integrating concept was prepared and delivered to ARI in November 1985.

The COTR then requested a briefing be prepared for CATA personnel which highlighted the integration and interpretation of the mission effectiveness criteria and the NTC organizational factors portion of the overall model. The briefing was conducted in late November.

Subtask 2.1: In December 1985, a research plan, based on the results and information obtained in the previous subtasks, was prepared. The plan operationalized the portion of the integrating model that has been briefed to the CATA personnel in November 1985. The research plan was presented to ARI in draft form in late December 1985. It was subsequently revised and provided the basis for ARI's determination that because of CATA's interest in application of the proposed measurement system, a change order should be prepared to permit development of the proposed system for all NTC missions rather than the prototype mission originally called for in the contract. The plans for the first year of the two year augmentation are discussed under Task 2A in the second section of this plan.

A recap of the progress made on the Task 2 requirements follows:

Subtask 2.1. A research plan was completed and presented an integrating model for NTC performance. The plan included a level of effort that exceeds the original Task 2 requirements. This was a result of additional guidance from the COTR and an anticipated augmentation to the original contract.

Subtask 2.2. Proposed efforts accomplished and exemplified by "Lessons From NTC" report. Additionally, the anticipated contract change order for Task 2 would require a considerably expanded effort to be performed in this area.

Subtask 2.3. Work done for Live Fire and Force-on-Force data analysis as well as NTC Lessons' battalion performance profiles.

Subtask 2.4. Work performed for Live Fire, Force-on-Force and NTC Lessons reports.

Subtask 2.5. Work accomplished for Live Fire and Force-on-force and NTC Lessons analyses.

Subtask 2.6. Draft completed and submitted to ARI.

Subtask 2.7. See below for reports published.

I.2.4 List of Significant Reports and Products. As a result of the above efforts, the following products were produced and are included in this report under separate appendices:

5.0 Comparison of the BFVS and M113 Equipped Battalion Task Forces on Live Fire Performance at the NTC

6.0 An NTC Live Fire Performance Analysis

7.0 A Briefing on a Concept and Methodology For Measuring Unit Combat Effectiveness at the NTC

8.0 A Research Plan for Developing Concepts and Methods for Measurement and Interpretation of Unit Performance

9.0 A Briefing On a Preliminary Analysis of NTC Force-on-Force Performance

10.0 A Preliminary Analysis of NTC Force-on-Force Performance

11.0 A Briefing on the Performance of Battalion Task Forces on the Live Fire range at the National Training Center (NTC)

12.0 A Research Plan for Measuring Unit Performance Effectiveness

13.0 National Training Center Research Issues

I.3 Task 3 -- Develop Guides to the Use of NTC Information

I.3.1 Intended Year One Outcomes

The purpose of this task was to develop and produce guides to serve as day-to-day reference documents for scientific and military users of NTC information.

The potential impact of the NTC data on the military and scientific community is enormous. The realization of its full potential is, however, severely challenged by the lack of a guide, or program, that would allow analysts to recognize what kind of data is available and how to properly interpret the data.

The proposed approach for accomplishing the requirements for Task 3 shows it to be a linear activity (Figure I-2).

It was to begin with subtask 3.1, which required the determination of major scientific and military community users (and needs) for an NTC information guide. This information was to become input to Subtask 3.2, during which the guides would be designed and developed. In Subtask 3.3, the contractor would be required to produce the requisite guides.

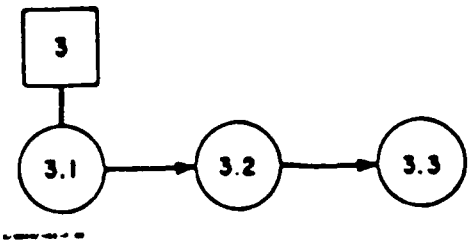


Figure I-2. Task 3 Sequence and Relationship of Subtasks

The methodology for accomplishing this task would be a straight-forward application of the three subtasks.

I.3.2 Events Influencing Task Performance

The initial activity for this task was the solicitation of information from potential NTC data users about their needs. Meetings were scheduled and conducted with the Infantry School at Fort Benning, the Armor School at Fort Knox, and the Combined Arms Center (CAC) at Fort Leavenworth concerning this issue. Feedback from these meetings indicated a need and interest in NTC data but

lacked specificity about the form and content of the information. This situation was clarified at the TRADOC/FORSCOM coordination meeting with ARI at CAC in the first month of the contract. It was jointly determined that the Combined Arms Training Activity of CAC should be provided with an example of how to use NTC data. The media for this action was to be transmitted in the format of "Lessons Learned." On March 15, 1985, the ARI COTR approved this Task Three action plan to develop a "Lessons Learned" strawman. The purpose of the task stated that a strawman was to be developed for CAC which reveals lessons and insights derived from NTC data and methods for extraction and synthesis of data into lessons and insights. The intended customers were to be brigade commanders and proponents. Lessons and insights using NTC data and experience were to be provided to brigade commanders and proponents for the purpose of improving training, doctrine, organization, and equipment within the Army. "Lessons Learned" were to be written in classical form patterned after historically acceptable, precedent setting documents. The focus is on those areas that the brigade commander can influence by training, organization, and training support conditions and resources. Some "lessons" will require action by a proponent other than the brigade commander. Recommendations of the "lessons" address specific actions that the proponents should take considering the particular "lesson" that has been identified. Provided within the text are graphics, explanations, and examples of methods used to synthesize information to assist CAC in developing follow-on "Lessons Learned" documents.

On April 2, 1985, an In Progress Review was held at ARI, Presidio of Monterey, California. The approved concept with specific examples and insights was briefed at this meeting.

In addition to the focused task plan described above, a second strand of effort was identified for Task 3. In response to a request from the Operations Group at the NTC, activity was initiated to design and produce training materials (guides) for the NTC instrumentation system.

I.3.3 Description of Year One Progress

The detailed purposes of the tasks were: 1) to proliferate the data and experiences emanating from the NTC into usable lessons; and 2) to prepare guides for the use of NTC instrumentation.

The Army has near term and long term needs for NTC data and information. The Army as a whole has not profited fully from the experiences gained by units that have trained at the NTC. Three years of training activity at the NTC have produced feedback to FORSCOM units during this training period. Training Observations, RED Thrust articles, Combined Arms Training Tips, and articles in TRAINER Magazine and service schools periodicals. These efforts, however worthwhile, do not fully realize the capability of the NTC instrumentation system and satisfy the needs of TRADOC and other

MACOMS. Because NTC capabilities have not yet been fully exploited, opportunities for change in the way that the Army trains, organizes, fights, and equips itself have been missed.

The major problem associated with the exploitation and proliferation of NTC data, information, and experience is the lack of knowledge among potential users. To remedy this problem it was felt that an external source knowledgeable of NTC capabilities must demonstrate the usefulness of NTC data, information, and experience in a particular user's area of proponency. It was determined that the preparation of NTC Lessons as a part of Task 3 would satisfy this condition.

The Army Research Institute (ARI), Presidio of Monterey, California (POM) assisted CATA by developing a prototype or Strawman "Lessons Learned" document which served as a guide for semi-annual "lessons" which CATA will produce.

The methodology used for developing the "strawman" is shown in Figure I-3. "Lessons" employed all available NTC information to identify strengths, weaknesses, and voids in training, doctrine, organization, and equipment. The following NTC products were reviewed and analyzed to determine unit strengths and weaknesses and voids in the support system:

History segment;

Task Force After Action Reviews;

Command communication tapes;

Segment video tapes;

Engagement Summaries;

Unit orders;

Research data base file reports; and

Unit after action reports.

The vast amount of available data on hand as a result of three years of NTC training precluded the identification of every trend supported strength, weakness, or void within the "Lessons Learned" strawman document. Also, in the interest of early delivery of a product to CATA the content within the document was necessarily limited. Major critical events and operational and organizational procedures were identified for analysis. These were identified based upon a comprehensive review of NTC data and information which determined the degree to which the NTC data and information supported identification and analysis of unit performance.

SUBTASK 3.1-- DEVELOP NTC LESSONS LEARNED STRAWMAN

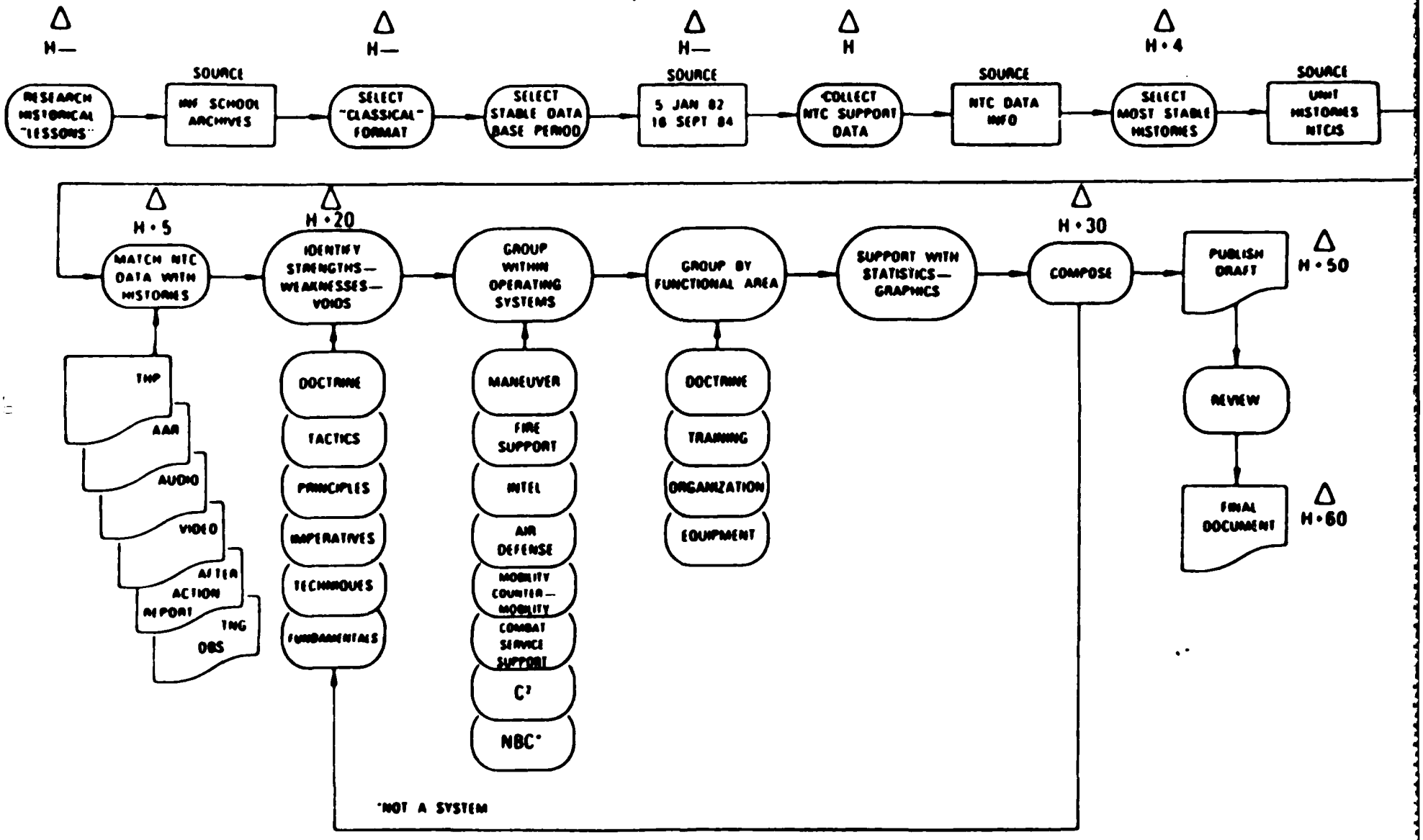


Figure I-3

Strengths and weaknesses, and voids which address doctrine, training , organization, and equipment were categorized within the task force operating systems. These systems are maneuver, fire support, air defense, intelligence, mobility - countermobility, combat service support, and command and control. A separate category of Nuclear, Biological, and Chemical (NBC) was also included.

"Lessons Learned" was written in "Classical" form patterned after historically acceptable precedent setting documents. The focus was on those areas that the brigade commander could influence by training, organization, and training support conditions and resources. However, some Lessons required action by a proponent other than the brigade commanders. The recommendations of the "Lessons" addressed specific actions that the proponents should take concerning the particular "Lesson" that had been identified.

The accomplishment of this task resulted in a model document from which CATA, CAC could develop and publish NTC Lesson Learned Documents (and CATA is now doing so).

I.3.3 Development of NTC Operating and Training Products

The second strand of effort in Task 3 was concerned with the design and development of products which meet the training and operating needs of personnel in the Operations Group at the NTC. As a result of a direct request from the Deputy Chief of Operations Group (NTC), "The DeAnza Primer: A Basic Introduction to the DeAnza Graphics Display" was developed to assist in the training of incoming Training Analysis and Feedback (TAF) Center Core Instrumentation Subsystem (CIS) personnel. "The DeAnza Primer" is an instructional document which presents a series of lessons and hands-on exercises that are designed to introduce new TAF/CIS personnel to an integral component of the CIS electronic monitoring equipment, the DeAnza Graphics Display tablet and monitor.

The lessons are presented in the form of a narrative tutorial with hands-on exercises which enable incoming TAF/CIS officers to learn the basic skills necessary for operation of the graphics tablet. The manual is comprised of six sections. Each section covers a different set of related functions. Sections are organized such that skills are learned sequentially (i.e., skills learned in Section 1 are required to learn the skills taught in Section 2). The exercises may be completed in a four and one half hour block of time and although it is necessary for the system to be primed (i.e., set up for the first exercise), close supervision of the learner is not necessary.

Another product was also developed for the NTC Operations Group. This product was viewed as a management tool and focused on the steps involved with the initialization of the NTC instrumentation system. The resultant report from this effort

described not only the specific steps in the initialization process but provided samples of all necessary forms and indications of the roles of key personnel and groups. The report was delivered to ARI in June 1985.

Also in November 1985, as a result of a coordination meeting with the CATA chief of the Army Lessons Learned Cell, Fort Leavenworth, BDM conceptualized a demonstration of a high technology, NTC Lessons Training technique. The effort is titled "What Now Captain?" and uses NTC instrumented historical battle segments as a teaching tool. A demonstration tape was prepared for the Commander, CATA, in February, 1986.

I.3.4 List of Significant Reports and Products

Products and reports which were produced under Task Three are as follows:

14.0 A Detailed Description of the NTC System Initialization Procedure

15.0 Lessons From the NTC

16.0 Interview Guide: Unit Home Station Training and Feedback System

17.0 A Briefing on the use of Instrumentation to Improve Combat Readiness

18.0 Research Plan for the Evaluation of Acoustic Quality and Research Potential of Communication Recordings from the National Training Center (NTC)

19.0 The DeAnza Primer: A Basic Introduction to the DeAnza Graphics Display

20.0 Script for "What Now, Captain?"

21.0 A Method of Analysis for the Investigation of the Bradley Fighting Vehicle at the National Training Center

I.4 Task 4 -- Determine Requirements for More Effective Integration of NTC and Home Station Training

I.4.1 Intended Year One Outcomes

The purpose of this task was to examine current Army training practices in order to identify strategies for:

1. Effective integration of NTC and home station training; and

2. Assessment NTC training benefits derived from current practices.

One of the main goals of the NTC is to provide units with a training environment which was more realistic and more combat like than the facilities at a typical home station post. The NTC provides a live and dedicated opposing force and instrumentation for real-time casualty assessment which adds a strong element of realism to unit training. Evidence that NTC has achieved this goal is found in the reports of participants and trainers who describe the NTC experience as a difficult one which substantially challenges the abilities of a unit and its leaders.

The fact that NTC is such a challenge can have either positive or negative impacts on the readiness of a unit, depending on the abilities of the unit itself. The training literature clearly shows that training exercises must be presented at an appropriate level of difficulty. If an exercise is too difficult, little or no training benefit will occur. Instead trainers become frustrated and demoralized, which may actually decrease readiness.

Attempting to match NTC exercise difficulty to unit abilities could be done in two ways. The difficulty of NTC exercises can be varied, or the unit can be pre-trained up to an appropriate level. However, any substantial reduction in NTC exercise difficulty to accommodate poorly trained units would compromise the goal of combat realism. It makes more sense to train units up to a level which allows them to gain the most from their NTC experience and maintain the level of NTC exercise difficulty as a standard which units can train for. In this context, the effective integration of NTC and home station training becomes an important goal.

Current practice for integration of NTC and home station training vary widely throughout the Army. Although the Army, by means of a FORSCOM circular (359-83-10), prescribes certain minimum NTC training activities, the actual extent of NTC/home station training integration varies considerably because of local training priorities, resource constraints, and assigned readiness levels. For example, the 24th ID has a division training policy designed to prepare units for NTC. Other units incorporate their NTC experience in a less formal manner (e.g., using it to modify their local training objectives), while still other units do not explicitly address the NTC experience in their home station training.

Task 4 was to be conducted in a sequenced series of its subtasks as shown in Figure I-4.

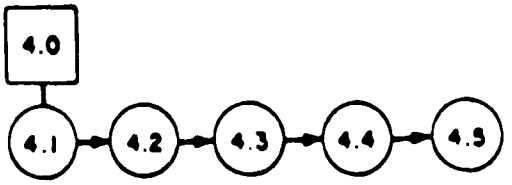


Figure I-4. Task 4 Sequence and Relationships of Subtasks.

In this approach, each subtask becomes a critical input to its subsequent subtask. First, a research plan (Subtask 4.1) must be developed to consider pre-NTC, NTC, and post-NTC training conditions. This plan was to drive the assessment and analysis efforts which would start with the development of the data collection instruments and procedures (Subtask 4.2), then move on to the actual collection of the data (Subtask 4.3), then analysis of the data (Subtask 4.4), and ending with a final report (Subtask 4.5) on this task.

I.4.2 Events Influencing Task Performance

The necessary operating agreements between the Army Research Institute - Presidio of Monterey and the Combined Arms Training Activity (CATA) at Ft. Leavenworth Kansas were not completely negotiated and signed until the last calendar month of 1985. This set of agreements provides the necessary Army support so that ARI can arrange for field support at the NTC during unit training rotations and with units at home station prior to and after the rotation. Without this agreement the unit contact aspects of this task could not take place. This problem prevented execution of Task 4.

Now that program support and a signed letter of agreement have been completed the formal barriers have been removed. The research completed in the first ten months has now provided a real platform from which both tasks eight and nine can be completed during the second year.

I.4.3 Description of Year One Progress

In executing Task 4, BDM performed the following activities.

Initial efforts concerned the identification and investigation of two major research areas: unit training activities and training-related conditions. These efforts were

aimed at dimensionalizing each area for possible use in the conduct of the investigation of Home Station Training. The activities undertaken in this report involved the examination of the issue by several NTC SME's. The result was an identification of factors or areas where the experts felt home station training could translate into better NTC performance. The selection of factors were restricted to those in the training activity area.

The second major area of activity for Task 4 was the preparation of a research plan to address home station training before and after deployment to NTC. A preliminary focus of this plan was on the interrelated conditions impacting upon home training. The conditions that affected the unit's ability to train both at home station and at the NTC were seen as critical to understanding effective integration of the NTC experience into Home Station Training. The research plan for the original subtask addressed both these conditions and the unit training activities.

I.4.4 List of Significant Reports and Products

22.0 Research Plan for the Evaluation of the Requirements for the Effective Integration of the National Training Center (NTC) and Home Station Training

Year Two

of the

Contract

INTRODUCTION

This section of the research plan presents a description of the tasks and activities to be undertaken in Year Two of the contract. Six tasks will be performed. The first five of these correspond to the Year Two tasks from the SOW (Tasks 6 through 10), while the sixth is an expansion of Task 2 Year One being conducted under as part of a contract augmentation. A brief description of each task follows:

- o Task 6 -- Analyze Unit Performance: This task has as its major focus the design and creation of a research data base for the NTC. As part of this effort, guides to the use of this data base will be developed.

- o Task 7 -- Develop Products to Support Training and Feedback at the NTC: This task has as its primary focus the design and development of guidelines for the After Action Review (AAR) and the Take Home Packages (THP) at the NTC. To accomplish this, the effort will address the exploitation of the advanced automation capabilities and the content and format of these feedback devices relative to the measurement system being developed in Task 2A.

- o Task 8 -- Develop Products to Support Home Station Training and Training Assessment: This task involves the development and field-testing of data collection instruments and techniques for use in describing Home Station Training. The instruments and techniques will draw upon the measurement system being developed in Task 2A and upon a model of the Army Training Process created as part of this task.

- o Task 9 -- Develop Products to Support Feedback to Army Users and Army-wide Utilization of the Products of the Research: While the task above focused on Home Station implications of NTC information, this task is concerned with dissemination of NTC information to the Army at large. As a first step in this effort, a survey of users from across the Army will be designed and conducted.

- o Task 10 - Prepare Proposed Third Year Research Plan: This task parallels Task 5 of the first year. That is, it requires the preparation of a plan which incorporates the previous results of the contract along with the originally proposed Year Three activities.

- o Task 2A - Develop Concepts and Methods for the Measurement and Interpretation of Unit Performance: This task represents an expansion and continuation of the work begun under Task 2 in Year One. It involves two central

activities: the creation of a criterion measurement system for of combat effectiveness at the NTC and the identification and measurement of critical tasks at the NTC. The results of this effort will be used as input to all Year Two tasks.

The accomplishment of the Year Two tasks will provide several important products to the Army and will greatly advance ARI's ability to measure and research battalion combat effectiveness. Using the Unit Combat Effectiveness Model (UCEM) developed in Year One as part of Task 2, it can be easily seen how the Year Two tasks advances the understanding of battalion performance at the NTC.

Figure II-1 displays the UCEM model with the Year Two tasks indicated as to their major area of effort. Task 6, involving the creation of a research data base, underlies all parts of the model concerning NTC processes, performance, and factors contributing to performance at the NTC. Task 7, concerning feedback methods at the NTC, are depicted as part of the feedback loop in UCEM. Task 8, Home Station Factors, is concerned with the model block entitled "Home Station Organizational Factors". Task 9, Develop Products to Support Feedback to Army Users, addresses the Army-wide dissemination of NTC Lessons Learned and is concerned with the furthest left portion of the model. Task 2A, developing measures of unit effectiveness and critical tasks, will result in specification and measurement of the right most block of the model entitled: "NTC Mission Performance Factors". Task 10 will tie all of these together for expansion and exploration in Year Three. As can be seen from this figure and the indicated Task Structure overlay, the Year Two tasks represent a comprehensive research effort of the UCEM model. In particular, it will result in a measurement system for the criterion portion of the model. This will leave the relationship of Home Station and NTC organizational and process factors to NTC effectiveness to be explicated in Year Three.

Using the UCEM model as the unifying concept for the Year Two efforts enables the individual research efforts to have a directed and related impact on the problem of enabling the Army to maximally benefit from the NTC. It also illustrates where the individual tasks necessarily impact on each other and how they do so. This relationship of tasks will further be explicated in the discussion of the individual tasks.

The organization of the remainder of this section of the research plan is by task. For each task, the discussion will be organized into four topics: purpose of the task, understanding of task, methodology for accomplishing the task, and anticipated reports and products. A milestone chart is provided at the end of each task discussion. At the end of the entire section, a staffing and loading chart is provided for all tasks.

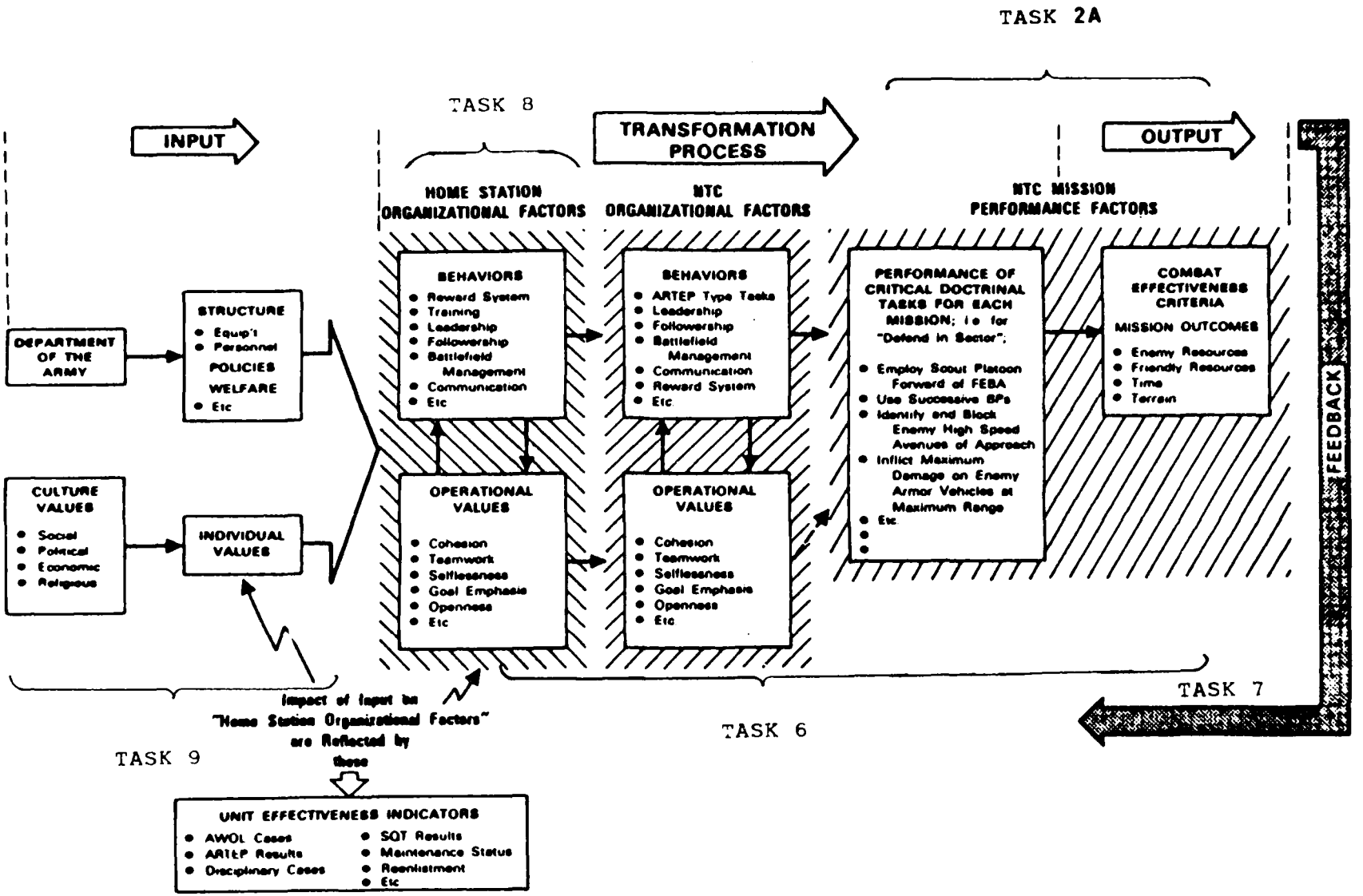


Figure II-1. Unit Combat Effectiveness Model (UCEM)

II.6 Task 6 -- Analyze Unit Performance

II.6.1 Purpose of the Task.

The establishment of an effective NTC data base is key to the analysis of Lessons Learned and the development of materials to support unit feedback at the NTC. Completion of Task 6 will be a major step towards this objective. Specifically, Task 6 is concerned with the redesign, development, and incorporation of an expanded NTC research data base, and documentation of procedures to utilize the data contained therein.

II.6.2 Understanding of the Task

The initial design of an NTC database, as implemented by the NTCDRS, has some serious shortcomings with respect to current NTC operations:

(1) The data contained within the NTCDRS databases are adequate to support only a small percentage of the research efforts possible with access to all NTC data.

(2) The data within the NTCDRS tables are arranged so that they are awkward to use. The development of useful database queries is difficult and time-consuming.

(3) Design of the present database structure is deficient, in that there are multiple occurrences of identical data, awkward data relations or keys, and common inclusion of data that can be derived easily from other tables.

In view of the model being developed under Task 2A, the NTCDRS will become obsolete without major changes and additions. Implementing even minor changes to the NTCDRS is difficult because of the lack of documentation of the input files and the inherent inefficiency of the table structures.

The best way to produce a data base that is consistent with the Task 2A model, that is useful in performing the kinds of research that ARI-POM will be called upon to do in the future, that can be adapted to meet the ever-changing challenges of the research environment, and that can be maintained efficiently, is to design and build a data base from the ground up.

II.6.3 Methodology for Task Accomplishment

The task will be comprised of three primary subtasks:

(1) Design and develop a useable NTC data base,

(2) Implement the data base, including retrofitting NTCDRS data and incorporating data from additional sources, and

(3) Develop a researcher's guide to document procedures and methods to use the data base.

II.6.3.1 Design and develop useable NTC data base

The first subtask concerns the redesign and development of the NTC data base so that it properly supports the NTC research objectives of ARI-POM. This is a long term process which will consist of the following steps:

(1) Requirements Analysis. This step specifies the data base, in terms of which data are required, including explicit definition, accuracy, units, and derivation, if necessary. The requirements analysis phase is driven by the research objectives, so a major portion of the activity here is in proposing the research course that will be supported by the data base, and in defining the data elements required.

As part of the requirements analysis, a review of all existing NTC data sources will be conducted and documented. This will include both digital and non-digital sources as well as data currently received at ARI/POM and data generated at NTC but not currently received at ARI/POM. Thus, the essential data set defined as a result of this analysis will include paper data such as the Take Home Packages, OPORDs, Scenarios, etc., as well as digitally captured data. Because of the diversity of the physical characteristics of the data sources and data elements, it is likely that the NTC data base will be a combination of computer and non-computer storage. At present, it is anticipated that the non-computer storage will be in the form of a rotation "log book". The log book would contain all paper data elements associated with a rotation. Further, the log book would be supplemented by copies of any analyses performed on the rotation. The result would be a continual expansion of the data associated with a rotation and an assurance that no data or analysis information is unavailable for future examinations.

(2) Design. This phase allocates the requirements into data base terms, including choosing the database structure down to the table structure, tables, and keys. As indicated above, the database probably will have both a computer and non-computer component. Also included in the design effort are complete specifications of all data sources, down to explicit format information, and design of the processes which will be necessary to incorporate the data into the new data base structures.

(3) Development. During this phase, the processes necessary to build the new data base are developed. The processes might include computer programs, command files, manual entry, data verification, derivation of some data elemnts, etc.

(4) Implementation Plan. This phase provides the transition into a production status, and ties all of the separate entities developed in the previous step into a working system. In the

ARI-POM environment, the implementation also includes the retrofit of data presently in the NTCDRS format into the new data base format.

II.6.3.2 Implement the redesigned data base.

This subtask implements the redesigned data base by following the implementation plan documented in the previous subtask. There are two basic functions that must be completed during this subtask:

(1) Convert data that was previously entered via the NTCDRS. This function consists of using a conversion utility to reprocess the NTCDRS data and produce a data base in the upgraded format. It should be recognized that the translation cannot be totally faithful, due to the lack of supplementary data that must be factored into the new data base format, which is no longer available for older rotations. For example, if the new data base includes data from the RDMS log, these data are not available for any rotations prior to 85-10, and for some rotations since then. Some supplementary data will be available, such as THPs, and will be incorporated as appropriate.

(2) Begin production on the most recent rotations. The assumption is that all necessary data will be available for rotations that occur after the data base design is finalized and additional data collection requirements are coordinated with the NTC. In this case, generation of the databases for current rotations should be fairly straightforward. However, it is recognized that actual production of the database will likely be interactive in nature, particularly as results of new analyses are added to the existing structure.

II.6.3.3 Develop Researcher's Guide to NTC Data.

Subtask 3 is concerned with documenting the contents of the NTC data base and in providing explicit guidance in accessing the data, manipulating the data, and generating reports from the data. This subtask will be based on a compilation of outputs from the data base design and implementation processes described under Subtasks 1 and 2. It will also include the development of training materials to guide researchers in all facets of NTC data base manipulation.

II.6.4 Anticipated Reports or Products

Activities performed in support of Task Six activities are list and described briefly below:

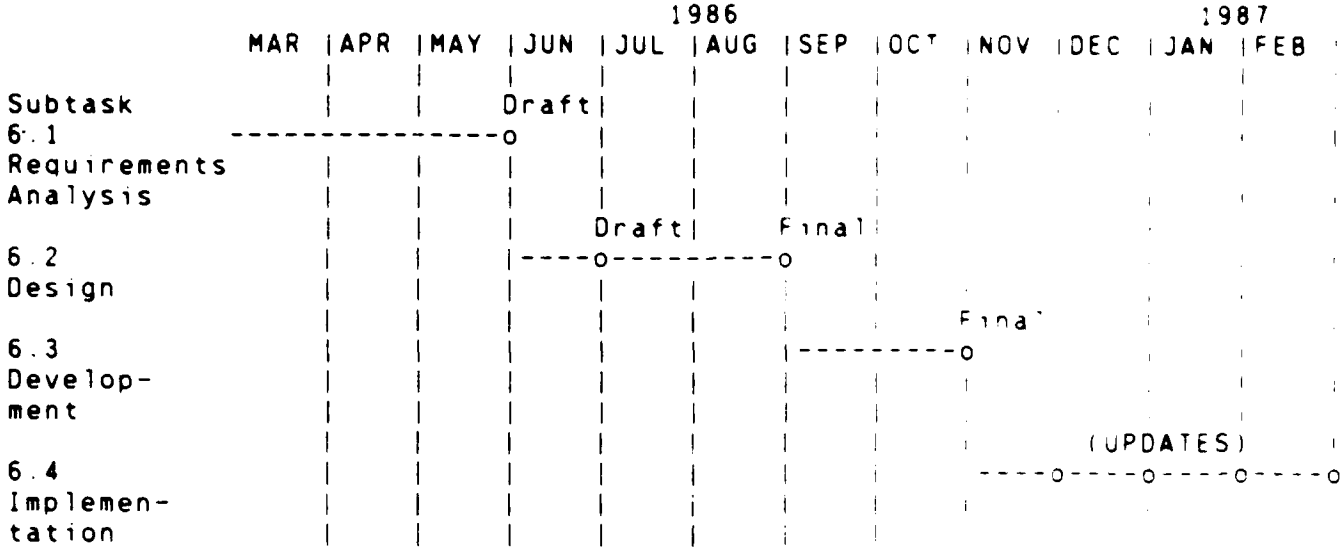
(1) An NTC Data Handbook, describing explicitly every facet of the NTC data base, including each data element, table structures and contents. The handbook will also contain the results of the requirements analysis.

(2) An NTC Data Manipulation Handbook, which describes how to access and manipulate data contained in the NTC data base. This document will also describe a number of "canned" procedures that will be made available to researchers to produce a number of standard reports from the data base.

(3) A short, "hands-on" course to introduce the research staff to the NTC data base. This course will be 4-8 hours, and will be required prior to allowing access to the data base. Subjects will include an introduction to the relational database system, an overview of the NTC data base and its structure, an introduction to the standards which must be followed in using the data base, including file, table, and procedure naming conventions.

(4) A periodic update of the data available to the research staff. This will be in the form of a computer listing which lists the segments available, some basic information about each one, and where the data base is (disk or tape).

Milestones for Task 6



II.7 Task 7: Develop products to support training and feedback at the NTC.

II.7.1 Purpose of the Task:

Increasing emphasis is being placed on more effective integration of NTC and home station training and the NTC's potential for addressing questions concerning training techniques, equipment, organizations, and doctrine. The purpose of Task 7 is to develop a systematic approach to the preparation of NTC After Action Reviews (AARs) and Take Home Packages (THPs) that takes full advantage the NTC Operations Group tactical experience, exploits advanced automation facilities and capabilities, and benefits from ongoing research in the area of Army training.

II.7.2 Understanding of the Task:

The Operations Group developed the current format for the AAR and THP in an uncertain environment that required both computer-supported and manual materials to be assembled for each AAR and THP. Trade-off decisions and compromise were necessary due to the immediate concerns of shaping an effective process that presented units with material to appraise the tactical performance of their task force. The resulting format was the product of both an evolutionary process and a common sense solution to the tasks at hand. The capability to aggregate and incorporate diagnostic performance information into the feedback packages (i.e., AARs and THPs) can be improved. In order to expand the current data capturing and aggregation capabilities with the result of improved NTC feedback processes, Task 7 must address two separate aspects of feedback development: 1) the format and content of the After Action Review; and 2) the format and content of the Take Home Package.

The AAR process is the most important training diagnostic function performed at NTC. As such, it is critical that it employ the full range of capability offered by the NTC instrumentation system as well as the observations of the OCs. Further, the content and structure of the AAR must be such that it contain the essential elements of performance which reflect the reasons and causes for mission outcomes. To accomplish this latter function, the AAR needs to incorporate the research results from a number of separate activities directed at leader performance, mission effectiveness, and critical task peformance.

Leader performance has been an area of considerable interest and activity at the NTC. In conjunction with CAL, ARI has been involved in a study of leadership at NTC and has developed plans for enhancing the effectiveness of NTC OCs in reporting on leader performance. It is anticipated that part of the benefit to be accrued from this enhancement would be improved AARs in the area of leader performance. One of the focuses for Task 7 will be the investigation of how OCs can better observe leadership tasks for inclusion in a prototype AAR. This effort will capitalize on the

work performed both by the ARI Leadership team as well as the contracted work performed for that team.

In addition to the leadership portion of the AAR, we will also include the work from Task 2A concerning mission effectiveness and critical task performance into the prototype AAR. By including the results from this effort, it will provide the AAR with a three dimensional structure of: leader behavior, mission outcome, and task force performance. We believe that NTC performance and the training implications from that performance can be fully described by these dimensions. Thus, the prototype AAR will be approached from this multidimensional perspective.

The second purpose of Task 7 is to develop concepts and guidelines for potential incorporation into the NTC Take Home Packages based on training and measurement concepts, recommendations of the NTC and unit personnel, home station training conditions and constraints, and results of performance analyses.

The THP currently is a trend-related document which summarizes improved and unimproved training and operational areas experienced by the unit during NTC training. Recommendations for further home station training emphasis are included for each deficient operating system. The THP document is supported by selected audio, visual, and computer-generated tapes.

Although the purpose of the THP is to change and/or reinforce home station training to meet levels of readiness proficiency required by the wartime mission, THPs currently are not designed as training schemes to be implemented upon redeployment from the NTC. The purpose of Subtask 7.2 in Year Two is to develop concepts for the THP based on training and measurement concepts developed in Task 2A, a model of home station training developed in Task 8, recommendations of NTC and unit personnel, and the AAR guidelines developed in this task so that it will support home station training by clearly documenting the performance diagnoses and proposed solutions to deficiencies identified in the AAR process.

II.7.3 Methodology for Task Accomplishment:

Task 7 will require the performance of two separate but related subtasks. Subtask 7.1 will result in the preparation of guidelines for the AARs. Subtask 7.2 will produce concepts and guidelines for Take Home Packages.

Four separate appraisals must be completed to address the requirements of subtasks 7.1 and 7.2:

1) The current state of AAR and THP methodology must be established. This should include a review of the organization and functional responsibilities of field and computer staff officers.

2) Guidelines and methodology for proposed AAR and THP content must be established and approved.

3) The results of the previous year's research and other training technology advances must be reviewed and utilized as appropriate.

4) The capabilities of the NTC computer system must be appraised at the time the research is started. This should include down range data transmission and displays, data entry and recapture at the TAF, and the range of data being captured, stored, and recovered by the NTC system.

The two subtasks require the production of two documents: Guidelines for After Action Reviews and a report containing concepts and guidelines for an improved Take Home Package. Having direct input into these subtasks will be the measurement concepts and methods for measurement of unit combat effectiveness developed in Task 2A, the leader effectiveness measures developed under this task, "lessons learned" documents developed in the first contract year, and various home station factors addressed in Tasks 4 and 8.

II.7.3.1 Develop Guidelines for After Action Reviews:

The steps to be followed in accomplishing this subtask are listed below. It should be noted that the activities directed at developing the concepts for the Leadership portion of the AAR will be performed separately though not independently of the remainder of this subtask. This organization will facilitate the efficient performance of this subtask in light of the varying interests of the proponent agencies.

Leadership AAR Tasks:

1. Review existing literature and prior ARI research concerning Leadership and Leadership Measurement.

2. Review, critique, and modify as appropriate framework developed for leadership measurement at the NTC.

3. Establish appropriate leadership performance dimensions.

4. Develop strawman observation guides.

5. Interview OCs for feasibility of framework at the NTC.

6. Revise and reproduce leadership guides for use in NTC NCO focus rotation.

7. Produce report on development and use of Leadership Observation Guides.

The tasks listed above will be accomplished within the timeframe of the second year of the contract. The tasks will be

performed as part of a larger ARI effort in support of an NCO focused rotation at the NTC. The use of this vehicle, i.e. the focused rotation, provides several advantages to the proposed effort. Specifically, it will define and narrow the focus of this initial work, it will result in the production of actual data collection devices, and finally, it will allow for field-testing of the devices. It is anticipated that the results of this first year effort will allow for direct expansion to other levels in the third year of the contract, input into the concepts and guidelines for the AAR, and application to Task 2A.

Mission Effectiveness and Critical Task Performance for AARs:

1. Review existing AARs and reference material to determine content coverage and appropriateness.

2. Interview NTC and Home station personnel concerning AAR presentation and effectivenees.

3. Using training and measurement concepts developed as part of Task 2A and Task 8, develop guidelines, concepts and protoype AAR content and structure.

4. Present to ARI for their review and their solicitation of CATA involvement.

Subtask 7.1 will reflect measurement concepts being developed in the areas of unit and leadership performance and will also be based upon inputs which can validate the training effectiveness of the AAR process. Accomplishment of this subtask makes will make a major contribution to the NTC and the Army as a whole.

11.7.3.2 Develop Concepts and Guidelines for Take Home Packages:

In this subtask, concepts and guidelines will be developed for potential use in the NTC Take Home Packages. As part of the effort, we will investigate the military and authorized scientific community to determine the true needs of those that use the THP. To the extent possible, the actual data collection for this investigation will be done in conjuction with the Task 8 and Task 9 efforts. In addition to the results of this investigation, the results of Task 2A and Task 8 will be drawn upon to identify concepts and guidelines for inclusion in the THP. It is anticipated that these will parallel the information in the AARs. From this output, concepts and guidelines for suggested improvements in the THP will be revised. Steps to be taken in developing the concepts and guidelines for the THP are:

1) Determine user needs
2) Survey sample users as to the strength and weakness of the existing THP
3) Review input and design requirements
4) Propose THP guidelines and concepts
5) Submit THP concepts and guidelines for ARI review

Examples of the data to be gathered for incorporation in the subtask are:

- who uses THPs?
- how and why are THPs used?
- what are the characteristics of the users?
- what is the environment the users operate in?
- what has been the impact on training and analysis from previous published THPs?
- what has been the relationship between successful NTC training and home station use of the THP prior to deployment to the NTC?
- what has been the impact on home station training methodology and BTMS as a result of THP use?
- have levels of performance improved as a result of THP use?
- what changes would unit personnel and users like to see in the THP?
- what Operations Group resources are available to produce required THPs?

Expected data sources include CATA, TRADOC, FORSCOM, NTC, FORSCOM units, Service Schools, and authorized analysis agencies.

The development of guidelines and concepts for the THPs is essential to maximizing the diagnostic training benefit of the NTC experience. Comprehensive and useful THPs will be primary contributions to the Army feedback system and Army-wide utilization of NTC data.

II.7.4 Anticipated Reports and Products:

At the completion of this task, BDM will produce working documents that address:

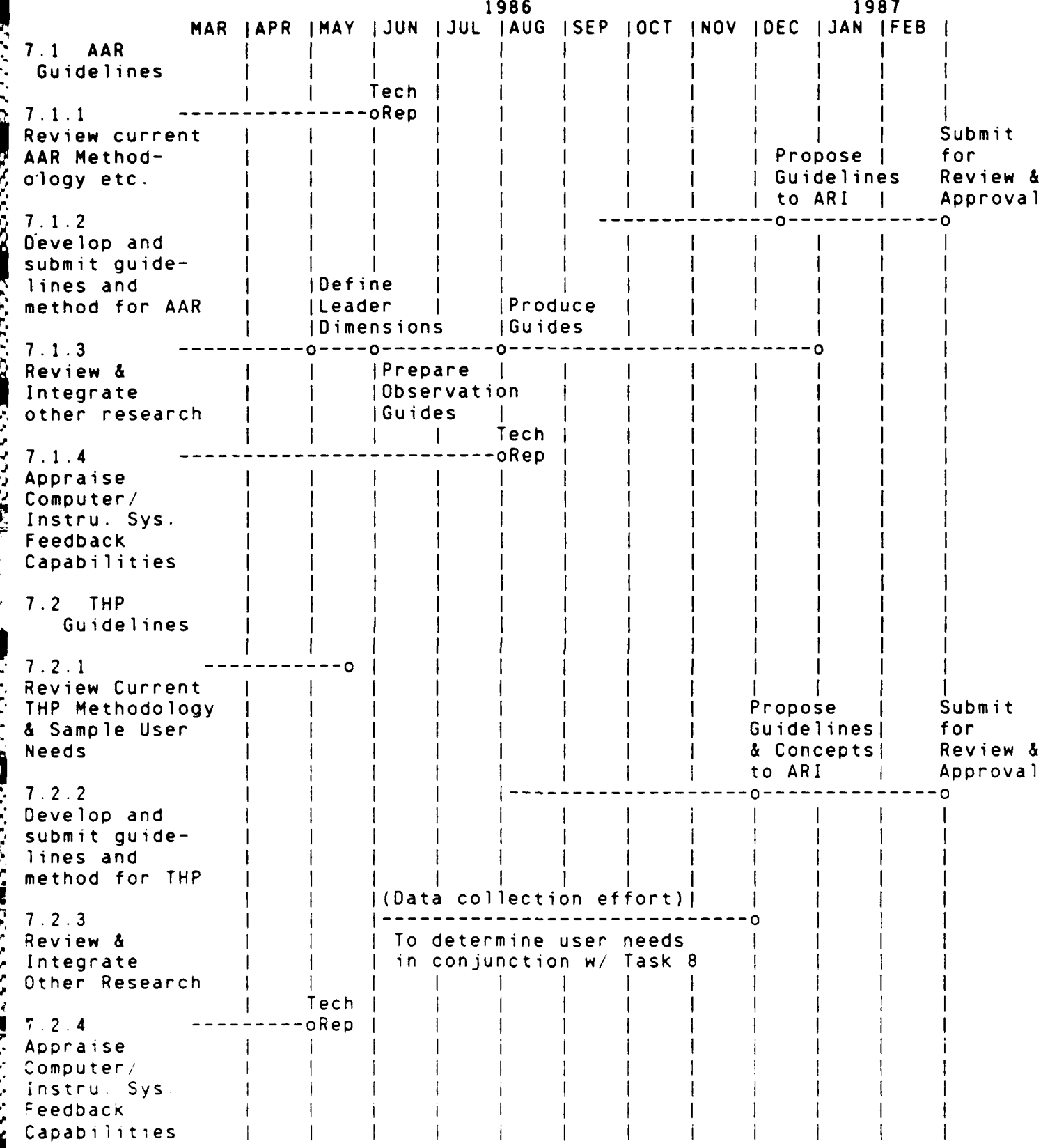
1) Format and content of the AAR based upon a diagnostic multi-dimensional model of unit performance

2) Develop and test feasibility of enhanced observation protocols for leadership tasks with OCs

3) An expanded concept for AAR presentations to fully use all the technology available at the NTC

4) Format and content of the THP based upon a diagnostic model of unit performance

Milestones for Task 7



II.8 Task 8: Develop Products to Support Home Station Training and Training Assessment

II.8.1 Purpose of the Task

In order for the Army as a whole to derive maximum benefit from the NTC, it is necessary that the training experience afforded at the NTC be institutionalized by the units at Home Station. Thus, the NTC experiences must be effectively integrated into a unit's active training program subsequent to its NTC rotation.

The purpose of this task is to develop guidelines for unit training at home station prior to and following an NTC rotation. The guidelines will include strategies for the effective integration of NTC and home station training.

II.8.2 Understanding of the Task

The NTC provides units a training opportunity that is unmatched in its challenge, scope, realism, and feedback. The high fidelity combat simulation allows units to fight as combined arms teams on an instrumented battlefield against an experienced opposing force that employs Soviet doctrine and tactics. Observer-controllers supported by the automated data base provide immediate feedback to the units in the form of Mission After Action Reviews. The After Action Reviews enable units to process performance data, adjust procedures, and operate repeatedly to correct deficiencies and improve performance while still at the NTC. Given the fidelity of the NTC as a combat simulation and the richness of the NTC training experience as an assessment and action planning tool, and recognizing that this opportunity is available to a battalion just once in an eighteen month period, units should be at a level of readiness that will enable them to derive maximum benefit from the NTC training. Their pre-NTC training posture should be such that they can cope successfully with the demanding scenarios and absorb and utilize the performance data. Following the NTC experience, units should be able to adjust training plans so that subsequent home station training activities correct deficiencies and build on strengths that were identified at the NTC.

Thus the effective integration of NTC and home station training is reflected in an annual training plan and program that enables units to prepare fully for the NTC, perform optimally at the NTC and move to higher levels of readiness at home station following the NTC experience.

Currently, there are no models or universal guidelines to assist units in effectively integrating NTC and home station training. As a consequence, training at home station and performance at the NTC vary widely throughout the Army. A primary objective of Task 8, therefore, is the development of products which will support an integrated unit training program.

II.8.3 Methodology for Task Accomplishment

Investigation of effective NTC-home station training will be accomplished over a two year period by following the subtask sequence shown below. The Year Two subtasks will be accomplished as contract Task 8 while the Year Three subtasks will be performed as contract Task 13. Each subtask is described below so that a comprehensive understanding of the investigation is afforded.

Year 2: 8.1 Develop Pre- and Post-NTC training constructs
8.2 Develop data collection methodology and plan
8.3 Conduct pilot data collection effort
Year 3 13.1 Collect pre-NTC, NTC, and Post-NTC data
13.2 Analyze data and develop report
13.3 Develop guidelines for unit training at home station

II.8.3.1 Develop Pre- and Post-NTC Training Constructs

Using information generated by work on Task 6 and Task 2A, BDM will develop an array of NTC performance factors and clusters associated with good performance at the NTC. This array will then be used to develop constructs which identify and describe the Pre- and Post-NTC training and support mechanisms which contribute to good performance at the NTC and subsequent efforts to correct deficiencies and improve combat readiness. Then, by analyzing these Pre- and Post-NTC training constructs and reviewing FORSCOM, TRADOC, and division training publications we will identify and target for data collection those relevant sources that will provide maximum information for conducting correlational analysis of home station factors and NTC performance factors. The preliminary major areas of focus for collecting data are seen as:

1. Training
   - Plans, schedules, and activities
   - Team/crew, squad, platoon, company, and combined arms proficiency
   - Facilities and support items
2. Personnel
   - Fill
   - Grades authorized vs. grades assigned
   - Individual qualifications
   - Time-in-position
   - Turbulence
3. Organizational Policy and Support
   - Training Philosophy
   - Command Climate

Concurrent with the work effort described above, BDM, in conjunction with ARI/POM will identify the six battalions (in three brigade rotations at the NTC) needed for the full data collection effort. Preliminary coordination with FORSCOM and TRADOC will begin to assure that the battalions are available and accessable during the study period.

II.8.3.2 Develop Data Collection Methodology and Plan

To attempt to establish linkages between the NTC training experience and home station preparation and follow on training activities, data will be collected on six battalions during two time periods: 1) one to two months prior to the units' move to the NTC, and 2) four to six months following the completion of the NTC rotations. A third, and much smaller, collection effort will be made on the last day of the NTC rotations to get commanders' and leaders' immediate reactions to the NTC training, their preparedness for it and their thoughts concerning follow-on activities at home station.

The methodology for collecting these data, the collection instruments, interview protocols, and a time-phased collection plan will be developed in this subtask. All such items will be prepared in draft form and submitted to COTR for review. In addition, BDM and ARI/POM will obtain FORSCOM/TRADOC approval and clearances for the data collection team's home station visits.

II.8.3.3 Conduct Pilot Data Collection Effort

This subtask involves the testing of data collection methodology, instruments, protocols, and procedures. The BDM data collection team will conduct one Pre-NTC home station visit, one end-of-NTC rotation visit at the NTC and one Post-NTC home station visit. The units visited during this pilot will not be among the six selected for the full data collection study, and the three pilot visits may be to three different units.

Based on results of the pilot, all components of this subtask will be reviewed and modified as appropriate.

Following the pilot collection effort, BDM will prepare a comprehensive report summarizing the task efforts through that point.

II.8.3.4 Collect Pre-NTC, NTC, and Post-NTC Data

Data for the six battalions in the study will be collected in three phases.

The Pre-NTC Phase. The BDM data collection team will visit the unit at home station and collect those data associated with training and support mechanisms previously identified as supportive of optimal performance at the NTC. This visit should be timed to enable the team to collect data which accurately and completely reflect the unit's state of preparedness just prior to the NTC training. Thus, it would be desirable to plan its visit no sooner than thirty days prior to NTC. Data will be taken from existing records and reports, questionaires completed by most leaders in the battalion and structured interviews of key leaders and commanders at company, battalion, brigade, and division levels. Approximately five to seven days of on-site work will be

required.

The NTC Phase. Members of the data collection team will interview the battalion commander, his principal staff officers and each company commander during one of the last days of the NTC rotation. The effort will be comparatively brief and will focus on participants' reactions to NTC training experiences, their views about how they could have prepared better and their thoughts on what should be done as follow-on training at home station. The collection team members will also coordinate directly with appropriate staff of the NTC to assure that all relevant NTC performance data are collected, packaged and promptly forwarded to the ARI field unit in Monterey.

The Post-NTC phase. This phase involves a second visit to the unit's home station. The focus of this visit will be to collect data which reflect the extent to which the NTC training experience was used:

a. To focus follow-on training plans and activities;
b. To correct deficiencies identified during the NTC experience;
c. To sustain and improve on the level of preparedness as reflected in the NTC performance.

Additionally, the team will collect information that will assist in identifying those home station circumstances and influences which help and/or hinder productive follow-on training at home station.

This visit should occur four to six months after the unit's return from NTC. By this time, the unit is likely to have: returned to normal routine; had time to reflect on the NTC experience; and made appropriate modifications to training plans and schedules.

Approximately five to seven days of on-site work will be required for this subtask.

II.8.3.5 Analyze Data and Produce Report

Data and information will be analyzed to reflect the profile of a single unit and also a profile accross units. Analyses will address the basic issues of training quality within the unit, training quality at NTC, the training conditions effecting both unit and NTC training, and the interrelationships existing between NTC and unit training performance. Comparative analysis will produce profiles of a unit's training condition indicating the forces which established the condition. Profiles will be compared among units to establish a common relationship of the impact that resource managers have on trainers. Quality indicators of the NTC training environment will be compared to the training profiles of the individual units. Analysis will surface requirements which show a need for greater NTC integration into unit training as well

as demonstrating the benefits of NTC to unit training activities.

BDM will prepare a draft research report on the integration of NTC and home station training. It is anticipated that this research report will be one volume or section of a larger final report which describes the entire research effort and the interrelationships among the project areas. The report will summarize the related literature, detail the research design and procedure, present the results of the research, and discuss findings and conclusions regarding requirements for more effective integration of NTC and home station training.

II.8.3.6 Develop Guidelines for Unit Training at Home Station

Based upon the results from the analyses and recommendations of the unit, NTC, and other appropriate Army personnel, guidelines will be developed which include recommendations for training type, echelon, frequency, and sequencing to best enable a unit to profit from advanced unit training at the NTC. Methods will be included for prioritizing and adjusting the training to home station constraints and conditions. These methods may include descriptions of training options and their relative benefits and costs (e.g., simulators and reduced caliber versus live fire, large unit FTX versus CPX, battle simulations, fire control exercises, small unit FTX versus drills, leader training, etc.).

This subtask will be a considerable effort. A single guideline cannot serve as a panacea for all units that train at the NTC. Every unit is different and every division has a different set of training resources, constraints, missions, leadership, and training environment. Every unit that trains at the NTC has its own particular set of training objectives. The scope of this effort increases with the introduction of air cavalry, air mobile, and light infantry into the NTC training arena. Therefore training guidelines must be tailored to meet the needs of each battalion task force that is scheduled to train at the NTC. It must be recognized that as senior commanders come and go, so training philosophies and associated resources and priorities change. While a training guideline may meet a need for a short period of time, the specifics within the guideline will be overcome by events. It is anticipated that guidelines will have to be continually updated due to the dynamic nature of command, training, philosophy, and resourcing.

The correlational analysis of home station factors and NTC performance serves as the foundation for the development of guidelines. Published Army training methods will provide the structure for the guidelines. This is essential for standardization purposes. Training needs will be balanced against training resources and time available. Recognizing that there is never enough training time available to bring units to level one proficiency, integrated and concurrent multi-echelon training will be inherent within the training cycle. The guidelines will reflect the NTC training performance assessment methodology.

Presently, assessments of unit and section performance are performed at platoon, company, and task force levels. Platoon and company assessments are based upon achievement of ARTEP mission/task standards and prescribed doctrine and tactics within the seven operating systems. These systems are command and control, maneuver, fire support, intelligence, air defense, mobility-countermobility, and combat service support. The guidelines must relate directly to the NTC assessment system to ensure compatible understanding and development of correct training objectives by the unit training managers. Guidelines will be highly descriptive and procedural. Types of training, applicable echelon of training, frequency, and sequence of training will be included within the guideline. Methods for prioritization and adjustments to training as caused by home station constraints and conditions will be designed. These methods will include descriptions of training options with relative benefits and costs. The steps to be followed in developing the guidelines are as follows:

(1) Conduct the correlational analyses of home station factors and NTC performance;
(2) Assemble and research any literature to determine the acceptable method(s) of training management;
(3) Determine training objectives;
(4) Determine training resources available at home station;
(5) Determine training constraints (e.g., money, time, personnel, terrain, ammunition, level of proficiency within echelons);
(6) Develop cost effective training options to meet training objectives;
(7) Develop and staff unit-particular training guidelines;
(8) Produce guidelines.

The data to be gathered will consist of the following:

(1) Historical NTC performance of the unit,
(2) ARTEP results,
(3) Army training methods,
(4) Training strategies,
(5) Training objectives,
(6) Constraints,
(7) Resources available, and
(8) Unit readiness profile.

Sources will include the correlational analysis, Army literature, unit and NTC personnel, and unit training records and reports.

The accomplishment of this subtask provides the training plan by which training managers will be able to develop a workable and viable training plan to improve combat readiness.

II.8.4 Anticipated Reports or Products

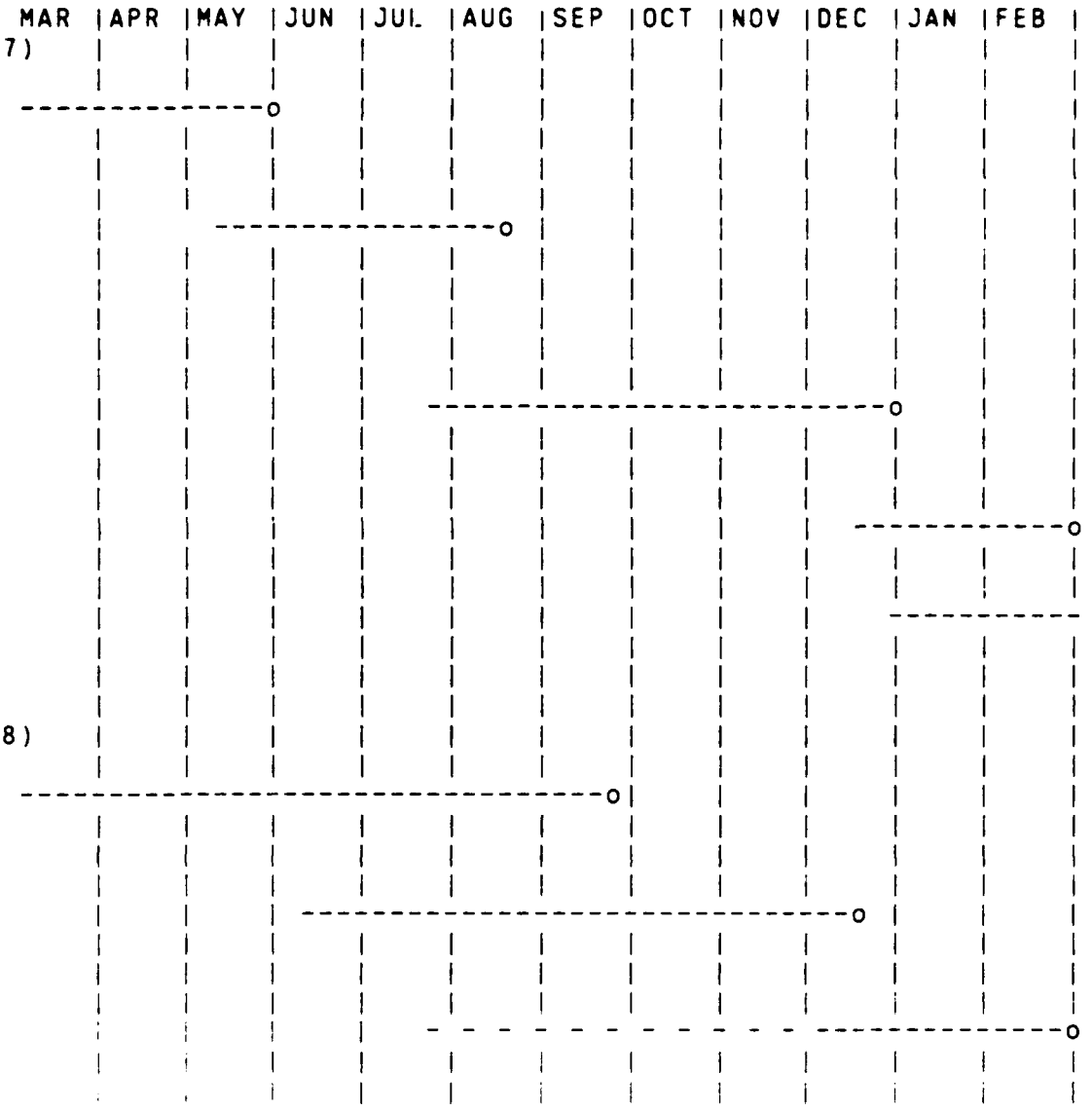
When the task is completed, BDM will have produced the products and reports listed below:

Year 2: 1. An Applied Model for Evaluating Home Station Training
2. A Methodology for Evaluating Home Station Training in the Context of NTC Preparatory and Follow-on Training
3. An Interim Project Report Describing Work to Date and Pilot Test Results

Year 3: 4. A complete report of the comprehensive data collection effort with correlational analysis of home station factors and NTC performance on eight to twelve units that trained at the NTC.

5. A set of guidelines for training type, echelon, frequency, and sequencing to enable a unit to profit from the NTC experience.

Milestones for Tasks 8 and 13



o = Products/Deliverables

II.9 Task 9: Develop Products to Support Feedback to Army Users and Army Wide Utilization of the Products of the Research

II.9.1 Purpose of the Task

The purpose of this task is to perform a front end analysis for a potential Lessons Learned information feedback system for the NTC. Its focus, then, will be on the creation of a methodology which might be employed in the creation and dissemination of Lessons from the NTC to other Army proponents. To accomplish this objective, the initial step is one of user identification and definition of informational needs. Task 9 has been designed to provide a comprehenive response to this objective and will involve the creation and conduct of a user survey to obtain the requisite information. It is anticipated that this information will include a set of high priority issues as well as identification of alternative ways in which NTC data might be used to address these issues.

II.9.2 Understanding of the Task

This task fully supports the charge by the Army Chief of Staff to exploit the NTC's full potential and spread the NTC experience throughout the Army. After five years of intense training experience, the production of feedback to proponent agencies is just now beginning. Feedback to the units involved in training has been immediate and comprehensive. Units receive daily feedback as to their tactical proficiency as a result of battle outcomes against the Warsaw Pact style OPFOR. After each battle, the unit receives a detailed review of its strengths and weaknesses as applied against prescribed tasks and standards demanded by the type mission. The rotational units have been the principal benefactors of training feedback. The brigade and division trainers gain feedback as to the performance of the battalions, companies, and platoons, and the respective leadership of those elements through personal observation and attendance at the After Action Reviews. Notwithstanding the fact that there is a requirement for improvements in the assessment and feedback system, the units do receive subjective and minor objective feedback of greater depth and significance than ever received in the history of warfare training. While real-time feedback requires vast improvement, the development of a feedback system and products to Army users worldwide is just now beginning. The Army's Training and Doctrine Command has established an NTC Lessons Learned division to capitalize on lessons from the NTC However, the training development community will require additional support from NTC to support quantum improvements in training.

The impact on the readiness posture of the Army and the international perception of other powers as to the ability of the Army to fight and win on any battlefield is directly influenced by NTC feedback. The early exploitation of NTC information is of such significance that feedback products must fully meet user needs.

The front end analysis represented in this task is designed to assist in the identification and deliniation of these needs.

The year one efforts were critical in surfacing initial military significant research issues. However, it is critical to continue to surface additional high priority issues, particularly for users in the Army at large. To facilitate this end, the survey to be developed for use with respondents from relevant proponents will solicit issues as well as their priorities and potential ways in which they might be addressed by NTC data. The NTC instrumentation system must be hardened and brought to its full designed operational capabilities to support this task. Refinements in data cleaning, analyses, and interpretation of data must be completed to ensure the availability and uilitzation of empirical data.

II.9.3 Methodology for Iask Accomplishment

A basic methodology for accomplishing this user needs survey and for the future development of feedback to the user is shown in Figure II-2. Although these two tasks are to be conducted during separate contract years, their unitary purpose warrants an identical methodology. The "Analyze" and "Design" requirements of the methodology apply to this specific task. The "Develop" and "Test/Evaluate" requirements will be addressed in Year Three.

II.9.3.1 Subtask 9.1 -- Conduct Detailed Survey of User Needs in Training and Doctrine Development.

The initial step in this subtask will consist of a search for potential Army users of NTC data and information. The search will not be confined solely to the training and doctrine development community, however. Users within the combat development community who are responsible for requirements concerning weapons, organizations, and equipment should also be identified. Our current understanding of the material development cycle and the current TRADOC-directed training development system/model will produce the primary relevant users; the military-experienced users responsible for developing weapons, equipment, and organizations. Surveys and personal follow-up contacts will reveal the exact format, detail, and media of NTC data required by the user. Beyond the NTC database, the research team will exploit other NTC sources to include non-instrumentation sources such as Fort Irwin (NTC) base operations, historical data and home station training information. At the completion of this task, the research team will formulate final recommendations for future changes in current procedures, where applicable.

The anticipated sequence of activities for the accomplishment of this front-end analysis is:

- Establish the appropriate target audiences for the dissemination of NTC information in coordination with

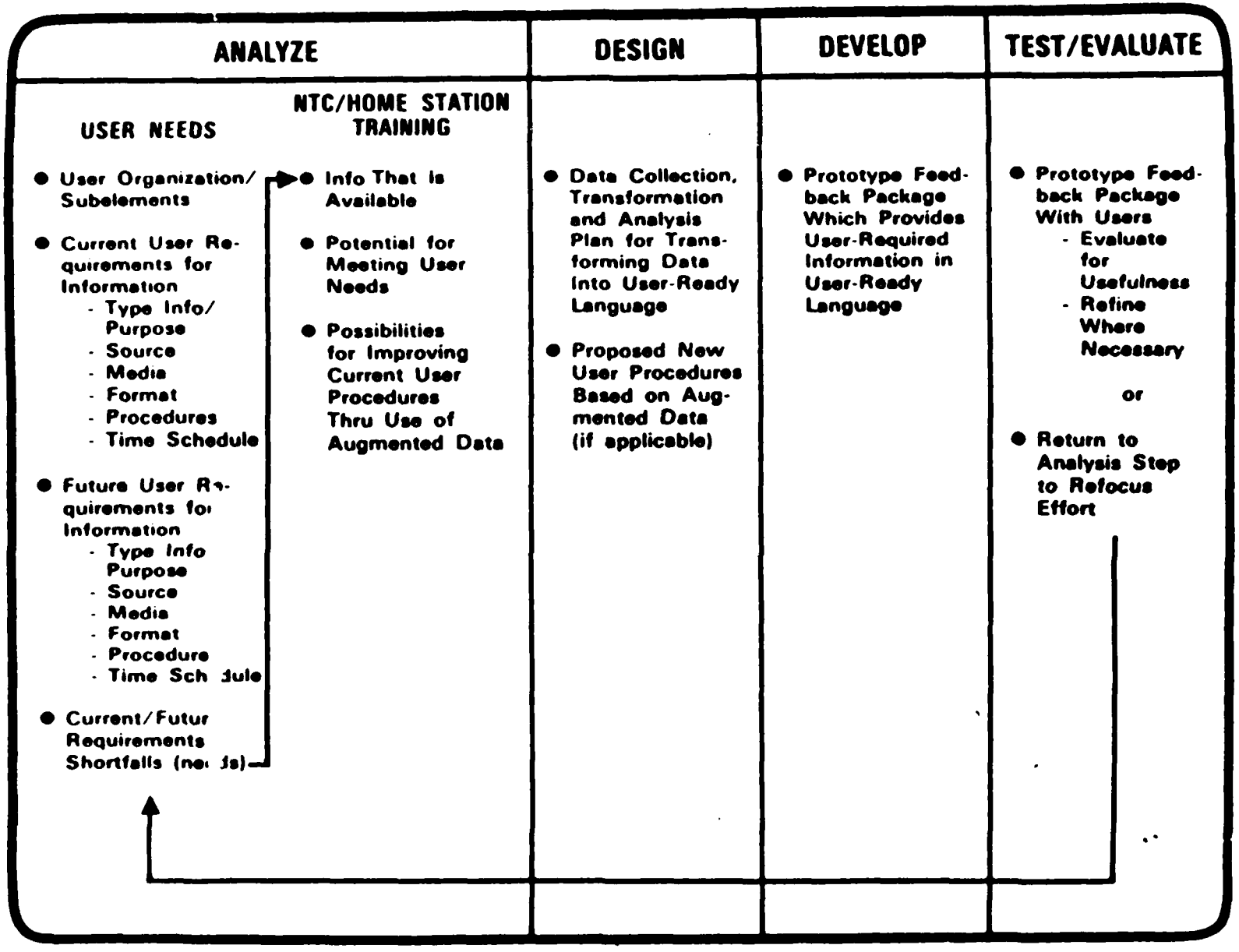


Figure II-2. Methodology for Producing Products Which Meet User Needs

and approved by ARI-POM. Other agencies will be included as appropriate.

- o Determine specific user, or potential user, organizations of NTC and home station training information through a top-down approach beginning with the Army proponent for NTC matter, OCSOPS, then to HQ FORSCOM and HQ TRADOC. Surveys may also be taken. Information and products of Task 3 will be highly useful in this endeavor.

- o Validate NTC and home station training informational access authority of these organizations through OCSOPS.

- o Determine current and future user informational requirements. This may include type information, purpose of information, source, media, format, procedures, and time schedules.

- o Ascertain current and future requirement shortfalls. These become user needs.

- o Review NTC and home station training information for compatibility with user needs. Where data are not compatible, it will be necessary to design a data collection, transformation, and analysis plan for transforming the data into compatible format.

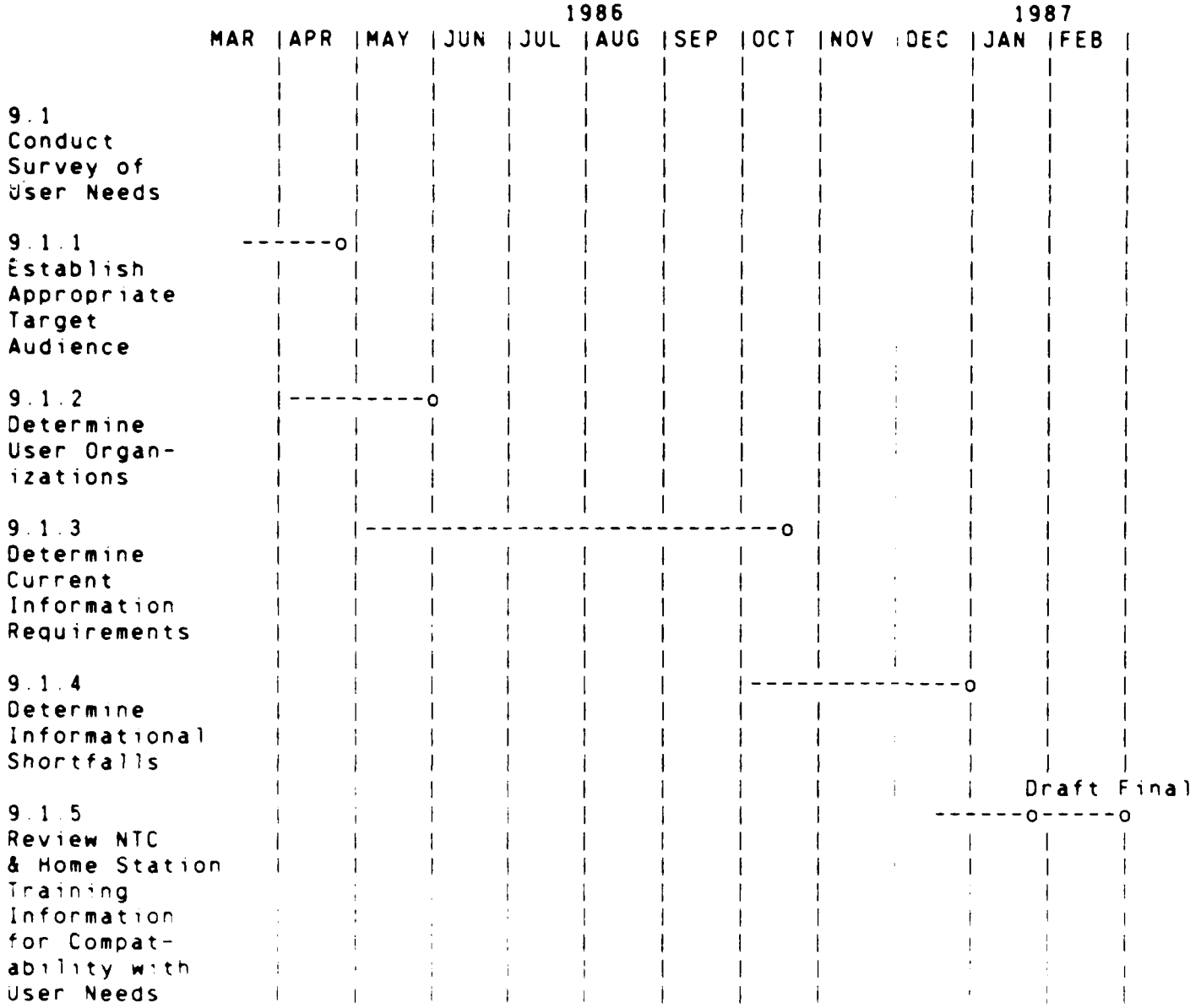
This will complete Subtask 9.1 and be followed by the "Develop" and "Test/Evaluate" steps to be performed Year Three.

This task accomplishment will allow the Army's full exploitation of high technology training in the areas of training development, doctrine development, and readiness assessment. Included is the exploitation of information and data for weapons, organizations, and equipment development.

II.9.4 Description of Anticipated Results or Products

A final report will be submitted which will describe the methodology, findings, and recommendations of the activities discussed above.

Milestones for Task 9



II.10 Task 10 -- Prepare Proposed Third Year Research Plan

II.10.1 Purpose of the Task

The primary purpose of this task is to prepare a proposed research plan for the third year.

II.10.2 Understanding of the Task

BDM is to prepare a proposed research plan for the third year based on the experience gained in the first two contract years, an understanding of the military and scientific areas of interst, and the overall research technical objectives. Any proposed tasks resulting from this effort must reflect its rationale and priority of effort.

II.10.3 Methodology for Task Accomplishment

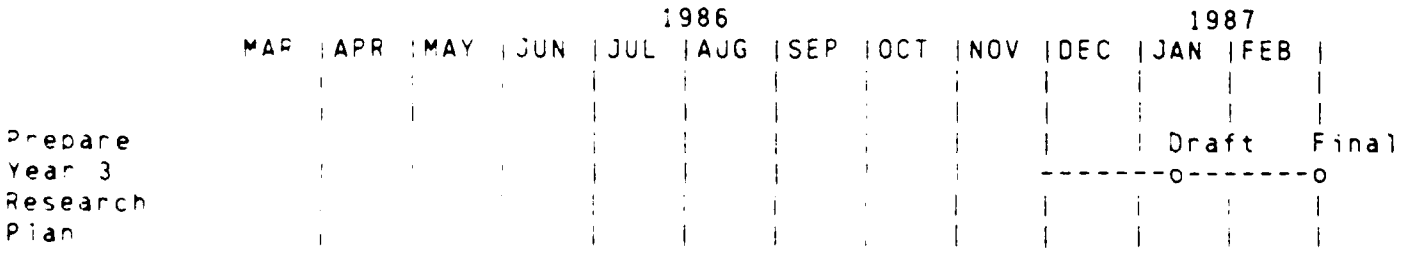
The methodology used for accomplishing this task will parallel that used for Task 5. In developing a research plan for the third year, BDM will first consider the accomplishment and shortfalls of the second year's effort for each task. Then, it will consider the impact that these findings will have on tasks 11 through 15 scheduled for the third year. Any additional tasks will also be considered (BDM assumes the purpose and technical objectives for the third year will remain unchanged. Therefore, any required adjustments will be made with this in mind.)

II.10.4 Description of Anticipated Results or Products

The research plan to be prepared for Year Three will be structured in the same manner as the current plan.

At the time this document is prepared, the COR will be presented a final draft and provided an opportunity to comment. The third year research plan will then be finalized, and delivered.

Milestones for Task 10



II.2A Task 2A: Develop Concepts and Methods for the Measurement and Interpretation of Unit Performance

This task represents an augmentation and expansion to the original contract. The work to be performed here is a continuation of the effort started in Task 2, year one. The present task has two distinct but related subtasks. The year two work to be performed on each is presented separately below.

II.2A.1 Task 1: Development of Unit Combat Effectiveness Criterion Variables.

II.2A.1.1 Purpose of the Task

The purpose of this task is to develop performance effectiveness criterion variables which are needed to identify the strengths and weaknesses in tactical doctrine and training.

II.2A.1.2 Understanding of the Task

The valid measurement of unit combat effectiveness during peacetime has been a long-term Army goal. Much has been written on this topic and many investigation have been conducted, all directed at combat effectiveness. The need for valid indicators of combat effectiveness is obvious. In particular, the Army has a need to determine its readiness state so that weaknesses and deficiencies can be identified and addressed prior to combat. Clearly, a valid measure of effective combat performance is a prerequisite for the analysis the strengths and weaknesses of any unit.

Prior to the NTC, however, it was virtually impossible to measure unit combat effectiveness because the units were not exposed to combat like conditions. Further, the variation in home station conditions and missions precluded the derivation of a single definition and measure of effectiveness. With the initiation of the NTC, the opportunity to empirically measure unit combat effectiveness became a reality. Since the NTC provides a limited set of conditions and scenarios as well as a variety of means for collecting performance data, it is possible to define and measure unit combat effectiveness.

The measurement of effectiveness at the NTC is seen as involving three critical pieces of information. The mission or nature of the task at the NTC must be understood so that effectiveness is measured relative to its performance. Second, data on the performance of certain critical tasks must be collected and compared to appropriate standards so that determinants of performance can be reviewed and critiqued. Last, the outcome of these task performances must be viewed in terms of absolute and relevant criteria. It is only when all of these elements come together that one can measure NTC effectiveness. The first step in the process of measuring unit combat effectiveness is the determination of the effectiveness of mission

performance. This concept is illustrated in Figure II-3.

Developing mission effectiveness criteria requires a determination of measures of effectiveness for each mission performed at the NTC at the task force and company levels. The METT-T factors provide a set of dimensions against which the performance results could be compared to determine the effectiveness level. The methodology for performing this task is described next.

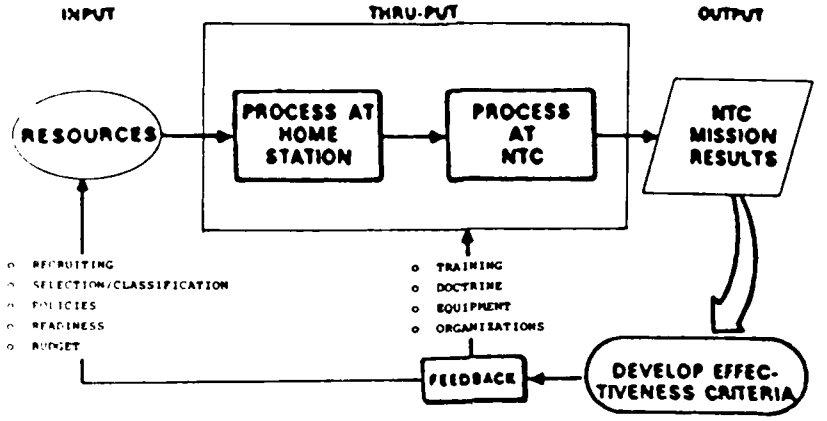


Figure II-3. Developing Feedback Based on Mission Effectiveness Criteria

II.2A.1.3 Methodology for Task Accomplishment

The methodology for accomplishing this task is through the undertaking of seven subtasks described next.

1) Subtask 1.1: Develop Measurement Model for Assessing Unit Mission Outcomes at the NTC.

The ultimate purpose for measuring unit effectiveness is to determine its antecedents in order to provide direction for training and doctrine formulation for the kinds of units being assessed. Implementation of this kind of an explanatory research requires the development of a model or conceptual framework which can be used to guide measurement development and testing. In this particular subtask, the requirement is to develop a model for measuring mission outcomes and evaluating performance effectiveness. The development of this model will continue the work begun under Task 2, year one, and will be a refinement of the model depicted in Figure II-4, below.

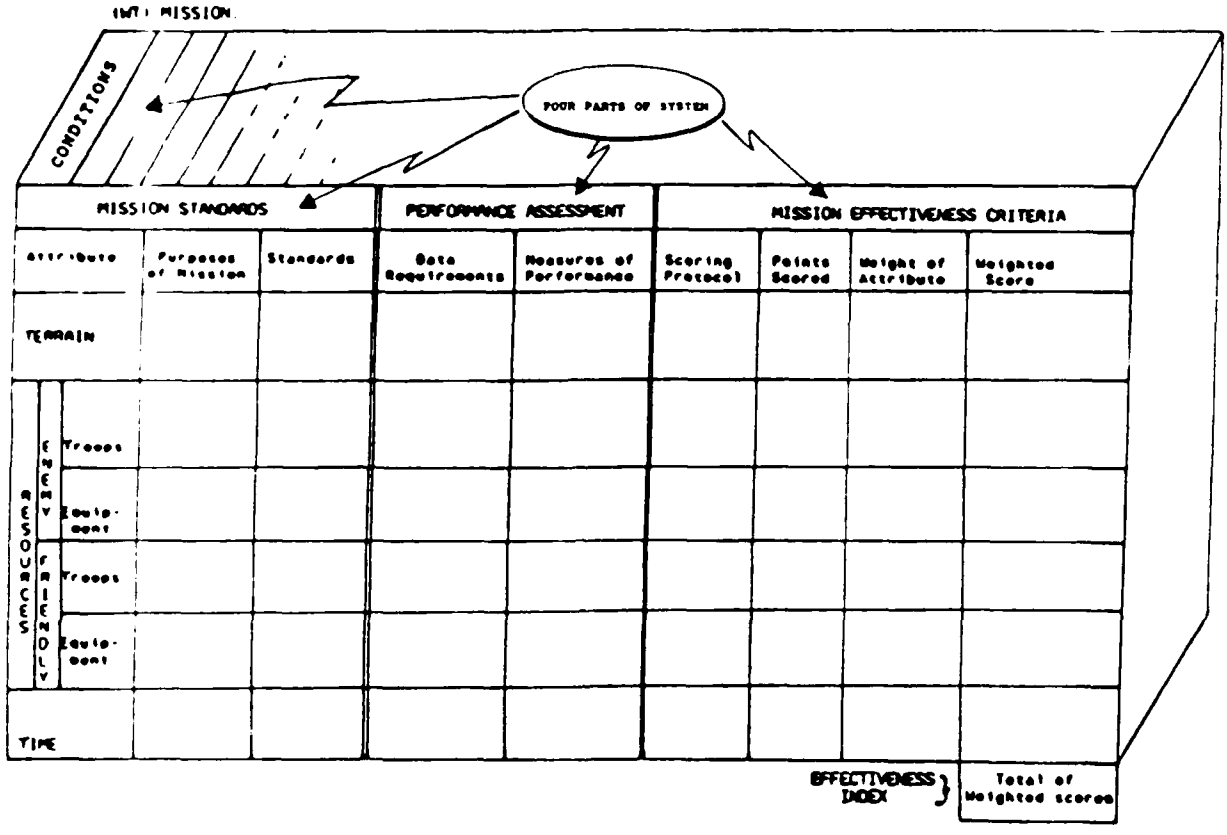


Figure II-4. A Model for Assessing Mission Outcomes

2) Subtask 1.2: Establish Performance Conditions.

In order to establish performance standards, we must first establish the varying conditions under which the task forces perform their respective missions. To accomplish this subtask, the battle scenarios used for each of the NTC missions (and rules for preparing variations) as well as information on other conditions likely to effect performance such as terrain, weather, task organization, etc., will be collected, reviewed, and documented. Our experience tells us that no two sets of conditions are exactly alike, as a "new" scenario is prepared and a new set of conditions occurs for each battalion task force. Therefore, the review process will likely involve 60-90 variations. However, we anticipate that our investigation will reveal a central core of common conditions that would have such impact upon expected performance results that they must be taken into consideration when determining performance standards. These critical military conditions will be analyzed and specified and a categorization of similar scenarios will be developed. ARI will request that CATA/NTC review the results of this subtask for suggestions and completeness.

3) Subtask 1.3: Set Mission Performance Standards.

In order to determine the effectiveness of a unit, its performance must be compared to some standard or desired level of performance. Such standards will be acquired from Subject Matter Expert judgments for each of the task force missions and related missions of subordinate elements through company team level, as a function of the scenarios and conditions. These standards must be expressed in measureable dimensions. ARI will ask CATA to review, revise, and approve. Figure II-5, below, is an example of this requirement.

Establishing the mission standards is the preeminent and most difficult subtask in this overall task effort. The concept of establishing mission standards is extremely difficult technically, as military mission outcomes are situationally dependent. This problem would be unworkable if we were considering every conceivable mission for every conceivable scenario in every theater of the world. However, this task will be feasible by limiting it to the NTC where the missions, scenarios, and Division Operation Plans are relatively standardized and the terrain, OPFOR, and externally imposed stress are a relative constant.

(MT) MISSION: DEFEND IN SECTOR

MISSION STANDARDS			
ATTRIBUTE		PURPOSES OF MISSION	STANDARDS
TERRAIN		PREVENT ENEMY VEHICLES FROM PENETRATING REAR BOUNDARY.	NO ENEMY VEHICLES PENETRATE BN TF REAR BOUNDARY (LINE XXX).
RESOURCES	ENEMY TROOPS	DESTROY THE ENEMY	INFLICT X% CASUALTIES ON ENEMY TROOPS.
	ENEMY EQUIPMENT	DESTROY THE ENEMY	INFLICT X% DESTRUCTION OF ENEMY WEAPONS SYSTEMS.
	FRIENDLY TROOPS	MINIMIZE CASUALTIES IN ORDER TO UNDERTAKE OFFENSE	SUFFER NO MORE THAN X% FRIENDLY CASUALTIES.
	FRIENDLY EQUIPMENT	MINIMIZE LOSS IN ORDER TO UNDERTAKE OFFENSE	SUFFER NO MORE THAN X% LOSS OF FRIENDLY WEAPONS SYSTEMS.
TIME		NOT NORMALLY A GIVEN PURPOSE FOR DEFEND IN SECTOR	

Figure II-5. Example of Mission Performance Standards

4) Subtask 1.4: Determine Measurement Requirements which will Result in Measures of Performance.

Once the dimensions of the standards are known we must then determine the essential elements of information required to produce MOPs that possess the same metric properties of the standard so that direct comparisons can be made between them. We will temper our approach by the availability and quality of the NTC data and by the capability of the assessment system to provide the required subjective and objective data. However, requirements for data not presently available will be accompanied by discussion of methods for collecting the required information. It will be a feasible and practical approach and the results closely coordinated with CATA/NTC. Figure II-6, below, displays an example of this requirement.

ATTRIBUTE			DATA REQUIREMENTS	MEASURES OF PERFORMANCE (MOP)
TERRAIN				
RESOURCES	ENEMY	TROOPS	% OF ENEMY CASUALTIES: CASUALTIES / PERSONNEL AT START x 100 = __%	ACTUAL MISSION RESULTS EXAMPLE: 43%
		EQUIPMENT	% OF ENEMY WEAPONS SYSTEMS DESTROYED: WEAPONS SYSTEMS DESTROYED / WEAPONS SYSTEMS AT START x 100 = __%	ACTUAL MISSION RESULTS EXAMPLE: 76%
	FRIENDLY	TROOPS		
		EQUIPMENT		
TIME				

Figure II-6. Example of Performance Measurement

5) Subtask 1.5: Design Criterion Performance Effectiveness Indices.

At this point the effectiveness of the unit performance on a mission can be assessed by using the measurement structure provided above, i.e., comparing the MOP with the standard. However, for research purposes these data would be very

unwieldy, given the number of missions and standards for each mission. Therefore, a method will be developed for reducing these scores into a more manageable and simplified effectiveness index. The outcome of this subtask will be submitted to a review of appropriate subject matter experts prior to finalization. Figure II-7 shows an example of this requirement.

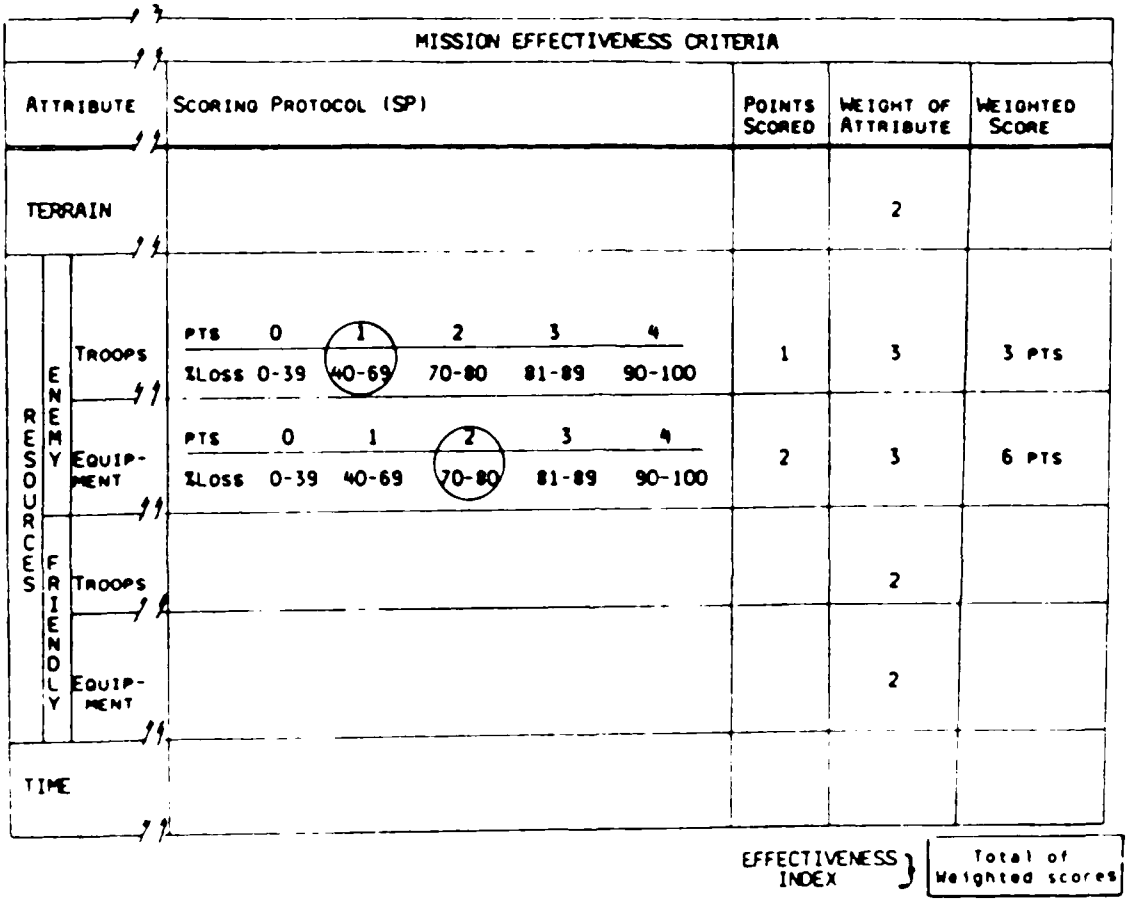


Figure II-7. Example of Criterion Performance Effectiveness Indices

6) Subtask 1.6: Test Measurement System Feasibility.

CATA/ARI will be asked to collect observational data in order to test the measurement system's feasibility. The results will be used to refine the system.

7) Subtask 1.7: Prepare Technical Report.

The measurement model and methodology developed for its use at the NTC will be documented in a technical report.

II.2A.1.4 Anticipated Reports and Products.

We will produce a measurement system for assessing the effectiveness of a battalion task force in performance of its assigned mission and a research tool for reducing that effectiveness score into an effectiveness index which will facilitate efforts in producing correlational analyses between mission performance and their corresponding task performances in the fulfillment of that mission.

II.2A.2 Task 2: Produce NTC ARTEP Supplement

II.2A.2.1 Purpose of the Task

The purpose of this task is to expand and refine the ARTEP specifically for use at the NTC.

II.2A.2.2 Understanding of the Task

The mission effectiveness criteria measurement system provides a basis for determining the contribution of organizational processes to mission outcomes. To complete this analysis one must be able to measure the performance of these organizational processess. This relationship and requirement is shown in Figure II-8.

From a training perspective it is not sufficient to know simply how well a unit performed a mission, rather it is necessary to examine the components of performance to identify areas of intervention. Through an understanding of the critical tasks and their influence on mission effectiveness, one can begin to determine the strengths and weaknesses of the unit's state of training and the Army's battle doctrine. The resultant information profile then allows training to leverage the Army's readiness.

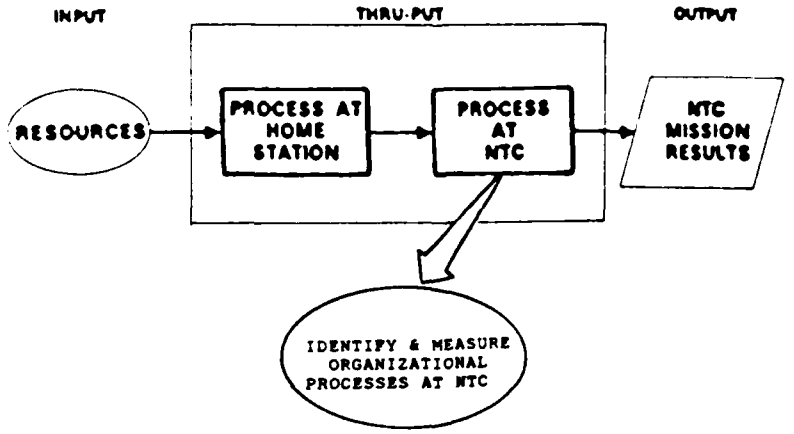


Figure II-8. Measuring Organizational Processess at NTC

The ARTEP is the heart of the Army's training program and as such should contain the critical tasks, conditions and standards for specific missions to which units, such as battalion task forces, can train. The limited and specific focus on NTC performance, here, allows for a more specific and narrow document than the current ARTEP. Detailed analyses of tasks critical to NTC missions, under NTC-specific conditions, for all elements of the battalion task force must be developed in order to derive this NTC supplemental ARTEP. The completion of the NTC supplemental ARTEP will allow one to relate doctrinal task execution to unit performance effectiveness. Further, mission conditions will be considered in the establishment of the standards for the critical tasks included on the supplement.

II.2A.2.3 Methodology for Task Accomplishment

The methodology for accomplishing this task is through the execution of eight subtasks described below.

1) Subtask 2.1: Develop Measurement Model for Evaluating Critical Task Performance at the NTC.

A model will be developed to provide the framework in which the critical tasks will be analyzed. This model, when operationalized, will provide a measurement system for use in evaluating critical task performance. The approach will be similar to that taken in Subtask 1.1 above resulting in a measurement structure resembling that in Figure II-9 below.

MISSION: DEFEND IN SECTOR

TASK STANDARDS		PERFORMANCE ASSESSMENT		TASK EFFECTIVENESS CRITERIA			
(1) CRITICAL TASKS	(2) STANDARDS	(3) DATA REQUIREMENTS	(4) MEASURES OF PERFORMANCE	(5) SCORING PROTOCOL	(6) POINTS SCORED	(7) WEIGHT OF TASK	(8) WEIGHTED SCORE

Figure II-9. Example of Structure for Measuring Performance of Mission Critical Tasks

The key features of the measurement structure will include a list of critical tasks and standards based upon mission conditions, measures of performance, and measures of task effectiveness. It is anticipated that research will reveal a variability in the contribution of critical tasks to mission requirements within and across missions; i.e., some tasks will be more important to mission accomplishment than others. Thus the relative weights of each critical task will probably have to be determined in order to equalize their individual contribution to mission results.

2) Subtask 2.2: Describe Mission Critical Tasks (and Activities) for the Task Force down to Platoon Level for each NTC Mission.

Using military SMEs and doctrinal publications relating to task force operations, an analysis of the critical tasks will be performed for each mission at the NTC down to platoon level. It should be noted that critical tasks are viewed as any unit function essential to mission performance. In this report, leadership functions that are unit responsibilities and essential to mission success would be viewed as critical tasks. These leadership or commandership behaviors are seen as being distinct from individual leader characteristics or behaviors and rather as organizational processes.

3) Subtask 2.3: Review Current ARTEPs.

The most recent ARTEPs for Battalion Task Forces and below will be reviewed for accuracy and completeness based on the critical task list developed in subtask 2.2 above and conditions specified for each mission from Subtask 1.2. Specific gaps or potential inaccuracies will be identified. ARI will present the results to CATA for review.

4) Subtask 2.4: Draft Task, Conditions, and Standards.

The gaps identified in the ARTEPs in subtask 2.3 above will be in terms of tasks, conditions, and standards which, when identified, will result in an NTC-focused ARTEP. In essence, it will represent a supplement to the current ARTEP for use at the NTC in accordance with the provisions in the ARTEP for CDRs to adapt the written ARTEP to their own local conditions. This subtask, therefore, requires the identification of the tasks, conditions, and standards that are missing from the current ARTEP. The conditions will be based on performance conditions documented for mission scenarios while the standards will be established by SMEs. ARI will submit for review, revision, and approval by CATA.

5) Subtask 2.5: Report Results.

The expanded/refined NTC-focused ARTEP and its development methodology will be documented.

Two areas of potential major difficulty exist in the execution of Task 2:

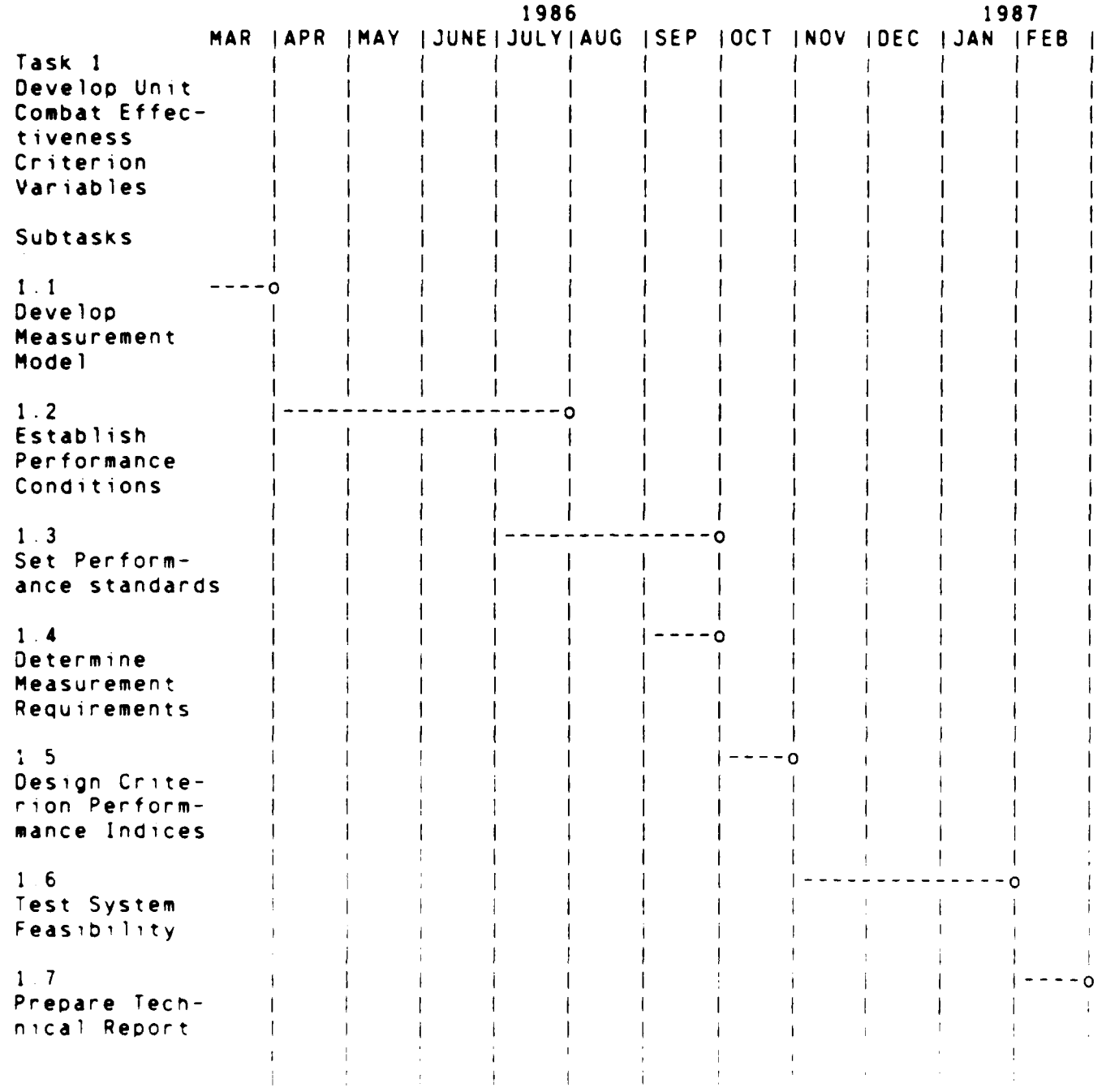
1) Developing a "supplement" to the ARTEP. Previous contract work with ARI on the subject of unit performance and ARTEPs revealed inadequacies in using the ARTEPs as a training document, particularly as they apply to the NTC. We expect, therefore, that considerable "restructuring" of the ARTEPs will result from this effort.

2) Setting performance standards to mission conditions. If the research effort reveals a large number of performance conditions for mission scenarios, The ARTEP supplement and observer guides could become cumbersome and impractical documents because of the multitude of conditions they would have to address. At this time, we do not anticipate that we will find an unmanageable number of mission- related conditons based on our current knowledge of NTC scenarios. However, should the opposite be the case, we are prepared to reduce them down to more manageable numbers by developing a scheme for categorizing the conditions.

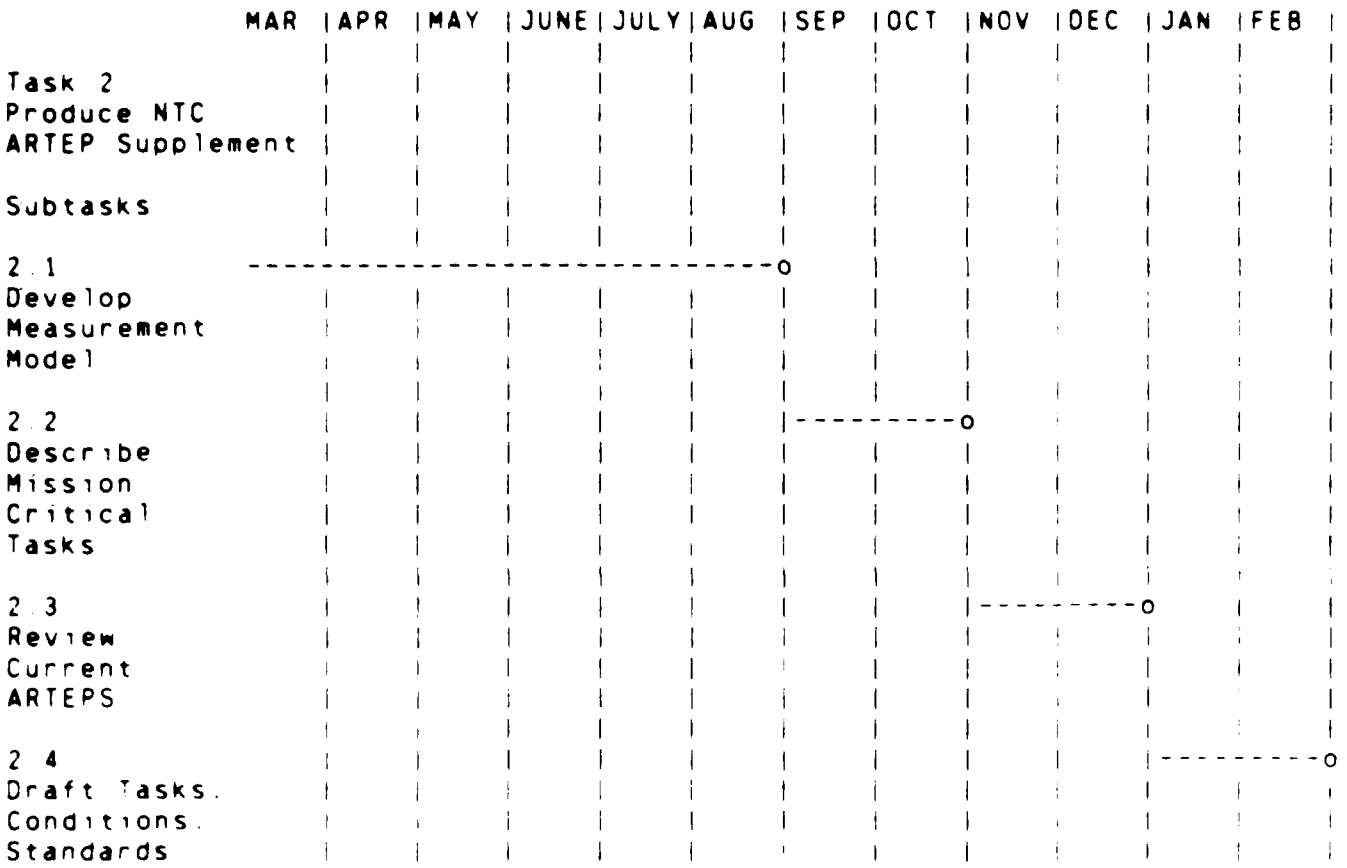
II.2A.2.4 Anticipated Reports and Products.

This task will result in the publication of an NTC-focused ARTEP containing critical mission tasks, conditions, and standards which, among other uses, will enable CATA to relate critical doctrinal task execution to unit performance effectiveness. This task will also provide a methodology for developing ARTEPs.

Milestones for Task 2A



Milestones for Task 2A (Cont)



TASK AND TIME MATRIX (PERCENT OF TIME)

YEAR TWO

NAME	TASK 6	TASK 7	TASK 8	TASK 9	TASK 10	TASK 2A
T.J. RITENOUR PROGRAM MANAGER	10	5	10	65	5	5
W.J. DOHERTY SENIOR SCIENTIST	10	30	15	15	15	15
T.K. FORSYTHE TASK LEADER	10	10	10	5	5	60
T.L. AVANT TASK LEADER	5	10	60	10	5	10
J.A. BRISCOE TASK LEADER	75	5	5	5	5	5
J.J. NICHOLS TASK LEADER	10	65	10	0	5	10
RESEARCH PSYC	5	20	10	10	5	50
MIL. ANALYST	0	10	0	0	5	85
MIL. ANALYST	0	10	0	0	5	85
E.A. KELLEHER ADMINISTRATION	15	20	20	10	15	20
T.R. KEMPER RESEARCH ASST	25	20	20	20	5	10